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THE PRESENT STATUS OF THE GENETICS PROBLEM[1]

THE problem of heredity has been attacked in four principal ways. Galton developed to a high degree what we may call the statistical method. His most important conclusions are embodied in his law of ancestral inheritance and his law of regression. According to the former, the two parents together contribute one half of the total inheritance of an individual, the four grandparents one fourth, the eight great-grandparents one eighth, and so on indefinitely. The law of regression attempts to state the average deviation of a fraternity from the mean of the general population in terms of the average deviation of the two parents. Recent investigations have shown that neither of these laws is true except for averages of large numbers of cases, and not in all cases even then. They are not applicable to individual cases, and are hence of no importance in the modern science of genetics, however important they may be in statistical problems in general.

In recent years the methods used by Galton have been developed by Pearson and others into a highly mathematical treatment of the subject of heredity, which has given us important means of dealing with the precision and reliability of data and enabled us to study certain types of correlation to advantage, but which has otherwise had comparatively little influence on the progress of genetics. The study of correlation between hereditary characters by statistical methods has not as yet led to

[1] Presidential address before the Washington Botanical Society, March 5, 1912.

discoveries of any great usefulness in the work of producing new and improved races of plants and animals, however useful it may have proved in other directions, or may yet be in genetics.

Another method of study has been that of the cytologist. A long list of able investigators have in recent years given attention to the phenomena of cell division, especially the process by which gametes, or reproductive cells, are produced. Very soon after the rediscovery of Mendel's principles cytologists pointed out that the behavior of the chromosomes in the reduction division is sufficient to account for Mendelian phenomena if a proper connection between the chromosomes and Mendelian characters could be proved. One of the most important results achieved in this line of investigation is the demonstration of a relation between certain chromosomes and the determination of sex. The work of Professor E. B. Wilson has been especially convincing in this respect, though many other investigators, especially Professor Morgan and Miss Stevens in this country, and Boveri, Baltzer and others in Europe, have contributed important results. The net results of these investigations are that in most species the female possesses a pair of chromosomes of peculiar character, usually distinguishable from the other chromosomes, and, because of their behavior in the prophases of the first maturation division, called by many cytologists "idiochromosomes." The male has only one of this type of chromosome. From the behavior of these idiochromosomes it results that all the eggs contain one idiochromosome, while the sperm is of two kinds, one containing a single idiochromosome, the other none. Eggs fertilized by the former produce females; by the latter, males. In a few species the female has only one of these peculiar chromosomes, while the male has none. In these species the female produces two kinds of eggs, one female-producing, the other male-producing; while the male produces only one kind of sperm. These investigations have thus given strong reasons for believing that sex is an inherited character, and is hence not determined by external conditions.

These facts have been demonstrated for a large number of species (over a hundred), including man.

While in most species the male possesses but one of these presumably sex-determining chromosomes, it frequently happens that this chromosome has a synaptic mate, which, however, appears not to be concerned in sex production. This synaptic mate consists in some cases of a single chromosome; in others it consists of a group of chromosomes varying in number from 2 to 5 in different species; in still others it is wanting entirely. These facts are of special interest in connection with the further fact that a large number of ordinary somatic characters have been found to form Mendelian pairs with the sex element. Thus, in barred Plymouth Rock poultry the barring of the feathers is transmitted by the female only to her male offspring. Many human affections are transmitted in a similar manner, such as night blindness, color blindness, etc. Pearl has shown that high egg-laying quality in poultry is similarly sex-limited. Females do not transmit this quality to their daughters, but do transmit to their sons the power of transmitting to the granddaughters high egg-laying quality. A long list of such sex-limited characters has been demonstrated. These facts raise the presumption that these sex-limited characters are related to the chromosomes—in what manner of course we do not know.

On the history of the chromosomes during the life history of the cell, especially

during the events immediately preceding the metaphase of the reduction division, cytologists are somewhat divided on matters of fact. They are in essential agreement so far as the genetic continuity of the chromosomes is concerned, *i. e.*, they believe that each chromosome is directly descended from a previous one. There are cases, however, where the propagation of the chromosomes is not a simple matter of division in which all the substance of the old body passes directly into the two new ones formed from it by division.

The manner of formation of bivalent chromosomes in the early stages of the reduction division is still a matter of dispute, as is also the possibility or probability of exchange of substance between synaptic mates. A review of the work on this subject would be highly interesting, but would extend this paper beyond all reasonable limits.

Recent work has shown that many chromosomes are really compound bodies, and that what we have regarded as independent chromosomes are, in some cases at least, really groups of chromosomes. This fact may have an important bearing on partial or even complete correlation between hereditary characters, as well as the fact that in some species more Mendelian pairs have been demonstrated than there are pairs of chromosomes.

A third type of investigations relating to heredity is the study of the chemical processes concerned in development. A great deal of the work of the physiological chemist has a bearing on this subject, though not instituted directly for this purpose. This study has led to the conclusion, as Guyer states, that at least a principal function of the chromatin is the production of enzymes which, by their regulating effects on metabolic processes, produce important effects in the development of the organism. Recently Gortner, of the Carnegie Institution, and Miss Wheldale, of Cambridge University, have attempted to work out the chemistry of certain of the pigments, with important results. For instance, Gortner has shown that, in the potato beetle, oxidizing enzymes are generally present in the body, while chromogen, which these enzymes convert into pigment, is produced locally in the integument in small quantity, and only in those locations where the characteristic pigment spots occur. One of our own members, Dr. Bartlett, is now doing some interesting work on the chemistry of anthocyan, and has become greatly interested in this phase of heredity investigations. Such investigations relate, of course, to the manner in which the hereditary characters make their appearance in development, not to the transmission of these characters.

This phase of heredity investigations is, as yet, only in its infancy. It is, however, one of the most important at the present time, for we can not go a great deal further in the interpretation of the phenomena of heredity until we know more of the chemical processes involved in the development of a complex organism from the fertilized egg.

Lastly, we come to the study, by experimental cross-breeding, of the behavior in inheritance of the various characters which distinguish nearly related organisms from each other. If relative importance were to be judged solely by the amount of data accumulated, this would be by far the most important phase of the subject before us. Here we have a plethora of fact and a dearth of meaning. We have now reached a point in the study of Mendelian inheritance where satisfactory interpretation of fact is quite as important as the collection of more facts. We need stimulating theories that will point out new directions for

research. When Mendel's laws were rediscovered practically simultaneously in the closing year of the last century, by de Vries, Correns, and von Tschermak, biology received such a stimulus as it has not felt since the publication of the "Origin of Species" in 1859. But what was it that gave this stimulus? Was it the collection of facts? Was it the wonderful collection of facts regarding variation made by Darwin that electrified the scientific world in 1859? Or was it a satisfactory interpretation of these facts? Darwin gave his facts *meaning*. Similarly, it was an *illuminating interpretation* of facts that made an epoch in the development of biological science when Mendel's principles were rediscovered. The fact that this discovery lay unnoticed for a third of a century and then suddenly became the leading interest of biologists is a remarkable commentary on the relation of science to human welfare in the last century and in the present.

The leading principle discovered by Mendel was that a hybrid whose parents differ in respect to a single factor of development, produces two kinds of gametes, respectively like the gametes of the two parents. This is now known as the law of segregation. In the early years of the present century genetic investigations dealt mainly with the universality of this law. This question is now practically settled, so far as can be by experimental cross-breeding. We now have a vast amount of data which need further interpretation that will point the way to new *kinds* of facts. The mass of data which has accumulated during the past dozen years has been variously interpreted by different investigators. It has furnished an extensive vocabulary of new terms, to which various meanings have been attached. Some recognized authority has suggested a new view concerning the nature of the so-called "unit-characters," and this view has been widely accepted with no critical examination of its intrinsic merits. The weight of authority here, as elsewhere, has been an incubus on the progress of scientific interpretation.

Mendel himself did not make use of the term "unit-character," but refers the phenomena he observed to *differences between formative elements* in the cells of hybrids. This is made clear in the following quotation from his original paper:

> With regard to those hybrids whose progeny is variable we may perhaps assume that between the differentiating elements of the egg and pollen cells there occurs a compromise, in so far that the formation of a cell as foundation of the hybrid becomes possible; but nevertheless the arrangement between the conflicting elements is only temporary and does not endure throughout the life of the hybrid plant. Since in the habit of the plant no changes are perceptible during the whole period of vegetation, we must further assume that it is only possible for the differentiating elements to liberate themselves from the enforced union when the fertilizing cells are developed. In the formation of these cells all existing elements participate in an entirely free and equal arrangement, in which it is only the differentiating ones which mutually separate themselves. In this way the production would be rendered possible of as many sorts of eggs and pollen cells as there are combinations possible of the formative elements. . . . The differentiating characters of two plants can finally, however, only depend upon differences in the composition and grouping of the elements which exist in the fundamental cells of the same in vital interaction.

Thus instead of "unit character" Mendel speaks of "differentiating characters," and instead of pangenes in the germ plasm he speaks of "formative elements," differences in which are responsible for the differences in related organisms. Nowhere does he advance the idea that the germ plasm is composed of independent elements, each of which is responsible for the development of a definite portion of the organism. The latter idea is due to de

Vries. Until within the last two or three years the de Vriesian interpretation of Mendelian phenomena has been widely accepted, especially in England and in Germany. Generally speaking, American biologists have hesitated to accept the de Vriesian doctrine, preferring to regard the developed organism not as a structure composed of definite elements independent of each other in hereditary transmission, but rather as a complex resultant of the interaction of various cell elements no one of which is wholly responsible for any definite part of the organism.

In consonance with the de Vriesian conception, the idea early developed that the organism is a collection of "unit characters" arranged in pairs, any one of which might be replaced by certain others. Bateson, in 1901, in presenting to the Royal Horticultural Society a translation of Mendel's original paper, uses the following words:

> In so far as Mendel's law applies, therefore, the conclusion is forced upon us that a living organism is a complex of characters, of which some, at least, are dissociable and are capable of being replaced by others. We reach thus the conception of unit-characters, which may be rearranged in the formation of the reproductive cells.

This is the first use of the term unit-character the writer has been able to find. The idea that hereditary characters are indivisible units is, however, due to de Vries. In de Vries's original paper on the law of segregation he remarks:[2] "According to the principles which I have elsewhere announced (Intracellular Pangenesis), the specific characters of organisms are composed of units quite distinct"; and, again, "for the simple character must be considered as an individual unit." The term "unit-character" did not come into general use until about 1905 or 1906. The fact that it presented a conception easily apprehended, and the further fact that this conception lends itself readily to a convenient system of symbols for representing the phenomena concerned, led to the rapid adoption of the new phraseology even by those who reserved their opinion as to the philosophy on which the idea was based.

We have already seen that Mendel himself referred the phenomena he observed to differences in formative elements in the germ plasm, which were "in vital interaction." The de Vriesian philosophy, on the other hand, did not place much stress on this vital interaction, but looked upon each hereditary character of the organism as the expression of a particular element in the germ plasm which was, more or less independently of all others, responsible for the development of that character. A pair of segregating characters, such as smoothness and wrinkling in pea seeds, was looked upon as due to a corresponding pair of pangenes in the germ plasm, one of which, if allowed free action, would produce smoothness, the other wrinkling. Bateson's term allelomorph was generally used to refer to these hypothetical organs in the germ plasm, rather than de Vries's original term pangene, since the former term could be applied to the visible characters themselves as well. Later, when certain non-contrasting characters were found to segregate from each other, Bateson gave this phenomenon the name "spurious allelomorphism." An example already given of such a pair of segregating characters which are not contrasted characters is femaleness and the barring of the feathers in Plymouth Rock fowls; this means that when the reduction division occurs one of the resulting cells carries the potentiality of femaleness, the other that of producing bars on the feathers. Many other instances

[2] I am indebted to Dr. Geo. H. Shull for the following citations relating to the history of the unit-character conception.

of such pairing of unrelated characters are known in both plants and animals.

About 1903 a new conception of the pair of allelomorphs arose. In that year, both Correns and Quenot foreshadowed what was more definitely suggested by Bateson and Punnett in 1905, as the *"presence and absence hypothesis."* C. C. Hurst the next year developed this hypothesis to its logical conclusion.[3]

According to this hypothesis the difference, say, between two varieties of cowpeas, one of which has red and the other white seed coats, is due to the presence of an allelomorph for red in the one case and its absence in the other. When the reducing division occurs in the hybrid this allelomorph was supposed to pass entire into one of the daughter cells, thus giving two types of gametes, one with, the other without, the potentiality of producing red pigment in the seed coat. It is usually assumed that the dominant member of the character pair corresponds to the presence, and the recessive member to the absence, of an allelomorph, though there are apparent exceptions to this rule.

While some biologists still adhere to the idea that the organism may be regarded as a structure built up of parts each of which represents a separately inherited character and is represented in the germ plasm by a pangene, this idea is much less prevalent than it was a few years ago. Recently the attempt has been made to formulate a description of Mendelian phenomena in terms that do not involve any hypothesis concerning the nature and interaction of the germ plasm elements which are certainly responsible for these phenomena. Notable amongst such attempts is the "genotype-conception" of Johannsen. Johannsen does not define very definitely his term "gene," further than to apply it to the cell organs or cell substances, whatever they may be, that are responsible for Mendelian phenomena. He particularly insists that the gene is not to be regarded as the basis in the germ plasm of a particular character, but that Mendelian phenomena arise from differences in corresponding genes in two varieties. This idea is in close accord with that of Mendel, which we have already discussed. Johannsen's gene and Mendel's formative element appear to be the same thing. Any particular character is probably the result of the interaction of several or many genes, and any one gene may bear a relation to many characters.

In a field of investigation where so much confusion has existed as to the meaning of terms, and where widely different views have been maintained as to the significance of the phenomena observed, it is necessary, in order to render discussion fully intelligible, to describe quite accurately the facts, which are not in dispute, and thus attach definite meanings to the terms used. It is not so important that we should agree as to the proper use of terms as that we should understand clearly the actual meaning of a writer, whether he uses terms correctly or not. In order that the meaning which I attach to the term "Mendelian factor" may be made clear, I shall set forth in some detail the facts about a group of these factors with which I have been working for some years past.

In my investigations of heredity in the cowpea (*Vigna unguiculata*) the seed-coat colors found are as follows: white (or cream), red, buff, blue, brown, black and purple. In addition to the simple colors above enumerated, certain varieties have the surface more or less thickly covered with bluish purple dots (speckling). In

[3] I am also indebted to Dr. Shull for these historical facts concerning the presence and absence hypothesis.

the New Era variety these dots are very numerous, while in the variety known as Taylor the dots are more thinly scattered, with considerable areas free from them. Certain other varieties, notably the whippoorwill, are characterized by a peculiar mottling of the surface in which irregular areas of darker shade are separated by lighter areas, apparently of the same coloring material, but less dense. There are also two genetically distinct types of "eye," the data concerning the inheritance of which have already been published.[4] Finally, certain varieties are characterized by irregular longitudinal stripes on the sides of the seeds. We have thus, in all, 13 pairs of Mendelian characters relating to the seed coat.

Except the purple color, the inheritance of all the above characters has been worked out quite completely. Purple was introduced into my crosses from a variety that had only a small color patch about the hilum, and was not recognized as a distinct color type until after the crosses had been made. It happened that the crosses made were not such as to bring out in full the relations of this purple color to the other Mendelian factors involved. Its inheritance will be investigated later.

Without postulating anything whatever as to the nature of the Mendelian factors involved in the development of these colors, I will first set forth some of the more important facts that have been worked out concerning which factors must be present in order that a given color may develop. Since we do not know what these factors are, and hence can not give them names based on their nature, and since we do know their behavior in inheritance and the relation of their presence and absence to the development of the colors, I shall give them provisional names based on their behavior and their relations to color development, and then, for convenience, reduce these names to mere symbols.

In no case is there a single Mendelian factor that can by itself give rise to colored seeds. I have been able to demonstrate that red, buff and brown seeds each require at least two factors. They may require others, but if so these others have not been detected. Black requires three factors and blue three.

If all these factors were distinct, these five colors would thus require twelve separate factors for their development; but the whole number of these factors for color (omitting purple) is only six. The same factor takes part in the development of more than one color. In fact, there is one that is common to the whole series, and when this factor is absent white seeds result, even if the remaining five are all present. We may designate this factor as the general color factor, and represent it by the symbol *C*. If we represent the other five factors by the letters *R* (red), *U* (buff), *Br* (brown), *B* (blue) and *N* (noir = black), the conditions required for the production of each color in this series, as shown in the breeding experiments, is shown in the following table:

CONDITIONS REQUIRED FOR DEVELOPMENT OF COLORS

Colors	Factors Necessary	Factors Having no Effect	Factors Which Must be Absent
White		*R, U, Br, B, N*	*C*
Red	*C, R*	*N* or *B*	*U, Br, B* or *N*
Buff	*C, U*	*R, N* or *B*	*Br, B* or *N*
Brown	*C, Br*	*R, U, B*	*N*
Black	*C, Br, N*	*R, U, B*	
Blue	*C, N, B*	*R*[5], *U*[5]	*Br*

In this table the names of the colors are given in the first column. In the second column are given the factors that must be

[4] *Amer. Nat.*, Vol. XLV., No. 537, September, 1911, pp. 513–24.

[5] These do not affect blue, but are visible with blue.

present in order that a given color shall appear. Thus none of these six factors is necessary to the production of white seeds. For red seeds there must be present the factors *C* and *R;* and so on. It will be noticed that the factor *C* is necessary in all the colored types.

The third column shows the factors whose presence or absence is immaterial in each color type. Thus white seeds may or may not possess any or all the factors except *C*. Judging from results secured by others in other species, there could also be white seeds possessing the factor *C,* provided all the other factors concerned in color production were absent, but thus far I have not found white seeds of this character in cowpeas.

In the case of red and buff seeded varieties it will be noticed that *N* or *B* may be present, but they may not both be present. The reason for this is that *C, N,* and *B* are the factors for blue; hence if both *N* and *B* were present in red or buff varieties these would be converted into blue. Opposite blue, in the third column, *R* and *U* are given as factors that may be present without modifying the blue color; while this is true, it is also true that these colors (red and buff) can be seen along with the blue in blue seeds. This seems to be due to the fact that blue is a sap color, and is usually not very intense, while red and buff are pigments in granular form. It is interesting to note at this point that these surmises of mine as to the nature of these colors have been confirmed by Dr. Mann, to whose work with these pigments I shall refer later.

The last column shows factors that must be absent in the various color types. Thus, if *C* is present, white seeds do not occur, unless indeed all the other factors are absent as well. The factor *U* can not be present in red seeds, for it would convert them into buff. In general, omitting blue, each of the colors named in column one completely conceals, or possibly prevents the development of, all those above it. Hence the factor *Br* can not be present in red and buff seeds. As already stated, the factors *B* and *N* can not both be present in red seeds, and the same is true of buff, though either of them may be present if the other is absent. The factor *N* must be absent in brown seeds, for otherwise we should have all the factors for black, and black renders brown invisible. Similarly, the factor *Br* may not be present in blue seeds, since it would change their color to black.

All the factors mentioned in this table are fully demonstrated in the experimental work, the full data of which will be published later. Not only that, but these factors, whatever they are, can be shuffled about and combined in any manner desired, practically at will. There are no intermediate stages to be dealt with. A factor is either present or not present, and that is the end of it. The only difficulty that presents itself in attempting to produce any color desired lies in the indifferent factors shown in the third column of the table. In some cases it is necessary to test a variety by appropriate cross-breeding in order to ascertain what characters are concealed in it, before we know what to expect when it is crossed with certain others. This will be necessary, for instance, in order to ascertain whether a brown variety possessed the factors *R* and *U*. It would not be necessary, however, to test any variety having colored seeds in order to learn whether it contains the factor *N,* for if *N* is present the green parts of the plant will exhibit anthocyan, which they will not do if *N* is absent. To learn whether a white variety contains *N* we should cross it with brown, in which case

the hybrid would be black or brown according as the factor *N* is or is not present.

This factor, to which I have given the symbol *N*, and which is necessary to the production of both blue and black seed-coat colors, is, as already stated, one of the factors for the production of anthocyan in the green tissues, and this was one of the reasons which led me to suspect that the blue pigment is a sap color. This same factor *N* is also one of those necessary for color in the flowers. But its importance in the economy of the plant does not seem to stop here. It may be merely a coincidence, but amongst about 4,500 third-generation plants grown in my experimental plots last year, this factor was present in every one of them that made even a fair yield of seed, except one strain of browns, and, with this exception, in those plants which lacked this factor the yield of seed was very meager. Furthermore, it is present in every standard variety of cowpeas in this country, so far as I have observed, although many varieties have doubtless been produced that did not possess it. These facts would seem to indicate that this factor is in some way connected with vigor and vitality in the plant.

Regarding the above colors, my breeding experiments led me to think that red, buff, brown and black were pigments related to melanin, and that blue was a sap color related to anthocyan. Dr. Albert Mann has made a study of this matter and has secured interesting and important results, which he will publish later. He kindly permits me to state that these surmises of mine were correct. I mention this fact to show that breeding experiments may be helpful to the chemist in investigating the chemical nature of these pigments.

We now have before us some of the facts that so badly need interpretation. The case is not nearly so simple as this statement of facts would indicate, for there are other important classes of facts that I have not considered because to do so adequately would require too much space. It is not surprising that such facts as these have led to much controversy. It is inevitable that the human mind shall attempt to comprehend what it clearly apprehends, and hence that theories of various kinds should have been proposed to explain these facts. When we consider the fact that these factors can be shuffled and recombined in every possible way, just as if they were concrete entities, each represented by an independent morphological element in the germ plasm, it was to be expected that theories should be proposed involving such elements. It is inevitable that this should have been the case. Such theories present a simple idea, easily grasped, leading to an almost absurdly simple scheme of symbols for portraying the facts of segregation and recombination.

Some of these theories have gone so far beyond the present possibilities of investigation that many biologists, especially those only slightly familiar with the facts of Mendelism, have entered vigorous protests, and have even gone so far as to try to rule the facts themselves out of court. I wish to suggest to those who have not themselves conducted Mendelian studies, that it is well not to be too dogmatic about the facts in a field of investigation with which one is not very familiar. It would be a serious matter to convince any one who has watched the shifting and recombining of these factors that they are not real things. For one not thoroughly familiar with Mendelian phenomena to question the *facts* of segregation and recombination is as unseemly and unscientific a procedure as it would be for me to question the facts of physiological chemistry. The real trouble is not with the facts. It is with the interpreta-

tion of these facts. Just at present we have more facts of a certain kind than we know what to do with. We need some one to put meaning into these facts. We are in the position of a man lost in a wilderness. What he needs to find is a road. It does not make so much difference where this road shall lead, for all roads lead into each other. If he can find any road, it will lead him to where he can find people, and these can point out other roads leading more nearly in the direction he wants to go.

In genetic investigations we need theories that will suggest lines of investigation that will be fruitful of results—that will lead, not to more facts of the kind we already have, but to new kinds of facts that will throw light on the subject from a new angle. "Theories," said Pasteur, "come into our laboratory by the bushel. When they have served their purpose, they are thrown out of the window." This has been so in the development of the science of genetics, but just at present the supply of theories is almost exhausted.

The things that need interpretation are the manner in which segregation and recombination are brought about, the nature of the things that segregate and recombine, and their relation to the processes of development. Mendelian factors, that is, those factors of development that behave in Mendelian fashion in heredity, of necessity relate only to those differences that exist between organisms that are closely enough related to cross-breed with the production of fertile progeny. In certain species crosses, and in some other cases in which there is reason to suspect either a diseased condition of the cytoplasm, or a departure from the normal behavior in gametogenesis, cases have been found in which the factors of development do not segregate and recombine in the simple manner represented by the Mendelian formulæ. Aside from these cases, it seems a fair inference from the results thus far obtained that the differences between organisms sufficiently related to permit of cross-breeding with the production of fertile offspring which reproduce sexually in a normal manner, are universally subject to the laws of segregation and recombination. There is one quasi-exception to this statement; there are certain factors that, instead of segregating in the usual presence-absence fashion, segregate from each other, so that they can not reside permanently in the same pure-breeding line. In my cowpea investigations I have found a set of three such factors; when only one of these is concerned in a cross we get the usual phenomena of presence-absence segregation. But if any two of the three are brought together in the same zygote they segregate from each other. These three factors are the factor *Br*, above mentioned (the special factor for brown pigment in the seed coat), and the New Era and Taylor types of speckling.

The question whether the deeper and more fundamental characters of the organism, such as are concerned in the differences between organisms widely separated in the organic world, are inherited in Mendelian fashion is purely academic and of no practical importance either to the theory of heredity or the practise of the breeder, for this question can never be submitted to experiment, nor could the most definite knowledge on this point be applied in the production of new and improved races of plants and animals.

At present Mendelists are plodding along practically without working theories. Let us hope that some of them will stumble on to facts of a new kind that will give meaning to those we already have.

Personally, I am of opinion that the chemistry of the pigments is a field that is of great importance to the theory of

heredity. The facts regarding the inheritance of color are better known than is the case with other groups of characters. The suggestion that the "factors" above mentioned are merely the power of producing certain chemical substances seems to me to be worthy of consideration. I believe that on this suggestion a new working theory of inheritance can be constructed that will explain the facts without recourse to the idea of "unit-characters," "pangenes," or any kind of character "bearers," in the sense of bodies or substances which are alone responsible for the development of a given character. It would be out of place here to attempt to present such a theory. I think, however, that an illustration of what I mean may be permissible. Let us suppose that a series of wireless stations, say in San Francisco, Denver, St. Louis and Washington, attempt to relay a message from the Pacific to the Atlantic. Now, if the St. Louis station should fail to do its part, the message would not arrive. In this case, we may not say that, if this station had done its part, it would have been *the* sender of the message. The relaying at that station is merely one of a chain of events that are necessary to the success of the experiment. But if St. Louis fails, then that station *is* responsible for the *failure* of the message to arrive at Washington.

The production of red pigment in the seed coat of the cowpea may possibly be a complex process in which every part of the living substance of the cell is concerned; but if a single cell organ which performs a necessary part of this process fails to play its part, then red pigment fails to develop. The cell organ whose failure to perform a usual function may thus be accountable for the lack of pigment formation might then be considered the "gene," as Johannsen calls it, for the *absence* of red pigment; while the whole organism might be the gene for the presence of this pigment.

In order that the study of the physiological chemistry of pigment formation shall give results of the greatest importance to the theory of heredity, it would be an ideal condition if such work could be carried out by one who possesses a wide acquaintance with the facts and theories in both these sciences. But such men are not plentiful. The next best scheme would be a cooperative study of the subject by two men, one in each field. I am happy to be able to say that Dr. Bartlett has consented to take up the chemical end of this work in connection with my investigations of the genetic phases of the problem, and Professor Piper has promised to grow the material for such study. Gortner's important work in this field, in connection with Dr. C. B. Davenport's work on genetics, has already been mentioned. With all these investigations, and those of Miss Wheldale and Professor Bateson at Cambridge, it is to be hoped that we shall gain a somewhat more definite view of the nature of Mendelian factors.

W. J. SPILLMAN

THE PERUVIAN EXPEDITION OF 1912

THE Peruvian Expedition of 1912, organized under the auspices of Yale University and the National Geographic Society for the purpose of carrying on geographic and anthropologic exploration in Peru, will endeavor to continue and extend the work of the Yale Peruvian Expedition of 1911, utilizing the discoveries made then and continuing further along the same lines.

It is our purpose to pursue intensive studies in the region where reconnaissance work was done on the last expedition, taking advantage of the discoveries then made to guide the plans for this year.

The work planned for the expedition is as follows:

I. In topography:
1. To make a topographical map on a scale of 2 miles to the inch, with a contour interval of 100 feet, of the Cuzco basin.
2. To connect that part of the Vilcabamba survey made by the topographer of the 1911 expedition with his trans-Andean cross section from Abancay to Camaná.
3. To make a map of the so-called Vilcabamba country which lies north of Cuzco between and including the valleys of the Apurimac and Urubamba rivers. Some portions of this were finished by Mr. Kai Hendriksen, topographer of the 1911 expedition, but owing to the difficulties of the route he was only able to make a beginning.

   Every effort will be made to complete the map of Vilcabamba, placing on it not only the ancient and modern sites, but also the data for further physiographical and geological study.
4. To map the routes connecting the later Inca capital of Vitcos with the rest of Peru.
5. To discover and identify the places mentioned in the Spanish chronicles and in the early accounts of Peru, particularly the places connected with the 35 years of Inca rule after the advent of Pizarro. As many of these place names have changed, it will be necessary to identify the places by a careful comparison of their situation and surroundings with the itineraries and descriptions given in the chronicles.

II. In geology:
1. To make a careful survey of the Cuzco basin and its vicinity, with special reference to the age of gravel deposits where human and other remains were found on the expedition of 1911.
2. To make a geological reconnaissance of the Vilcabamba country, continuing the work already begun.

III. In meteorology:
1. To establish and equip meteorological stations at Cuzco and at Santa Ana, stations at which continuous observations may be made for several years, these observations to be supplemented by field observations taken by various members of the expedition wherever practicable.

IV. In pathology:
1. To study the various diseases throughout the region visited, and their geographical extent.
2. To study the effect of coca chewing.

V. In osteology:
1. To study the bone deposits in the Ayahuaycco quebrada where human and other bones were found on the 1911 expedition.
2. To collect osteological material not only in the Cuzco gravels, but also in the mountains of Vilcabamba.

VI. In forestry:

To make a reconnaissance survey of the Vilcabamba region between the Apurimac and the Urubamba valleys.

VII. In anthropology:
1. To take photographs and physical measurements of native types throughout the region visited, with particular reference to a study of the distribution of the more important groups.
2. To collect material for a study of the distribution of types of cranial deformation.

VIII. In archeology:
1. To make a thorough investigation of the region round about and north from Cuzco and Pisac, photographing, measuring and describing whatever architectural material presents itself.
2. To continue the investigation of the ruins discovered on the expedition of 1911.
3. To penetrate still further into the jungles of the Pampaconas Valley and beyond, to see whether any more remains of Inca occupation can be found.

The expedition will include a geologist, an osteologist, a surgeon, three topographers and three assistants, besides the director. The geologist will be Professor Herbert Gregory, Silliman professor of geology in Yale University, and the osteologist, Dr. George F. Eaton,

curator of osteology in the Peabody Museum of Yale University.

HIRAM BINGHAM,
Director of the Expedition

SAMUEL BUTLER AND BIOLOGICAL MEMORY

THE present vogue of the books of Samuel Butler—not a great vogue but one fairly commensurate, perhaps, with the scientific worth and general interest of his writings—has led me to a rather critical reading of the four books and several scattered essays of this partly scientific, partly artistic, mostly iconoclastic, and wholly clever and epigrammatic modern namesake of the greater Samuel Butler of two centuries gone.

He finds himself dubbed in the British Museum Library catalogue as "philosophical writer," being alphabetically bestowed between "Samuel Butler, bishop" and "Samuel Butler, poet"; and in one of his essays tells a pretty story to account for his title.

The library catalogue is, as many will recall, printed and pasted in huge tomes, hundreds of them, and changes in its arrangement are not easily made. When our Butler found himself beginning to get into the catalogue he found also that he was getting mixed up with his namesake bishop and his namesake poet, and as yet he had no distinguishing title of his own. When he complained to the Library directors of his trouble it was pointed out to him that it was largely his own fault in not having sufficient distinction or distinctiveness to be classified properly. He must have a title. What was he, really? His writings were partly about Italian art, partly about the authorship of the Odyssey, partly about evolution and partly of the nature of stories. How was he to be distinguished? Had he any title? He replied, after meditation, that he was a Bachelor of Arts. The director pointed out that as far as his book titles were not actually confused with those of the bishop and poet, they were pasted in between theirs, and that if he were catalogued as "Samuel Butler, B.A.," the strictly alphabetical sequence of the catalogue would be wronged. Could he not, perhaps, arrange to be a Master of Arts? Butler replied that he understood that Cambridge stood one a Master for five guineas, but he was not willing to go above three guineas ten! Well, anyway, was the answer, he must be "Samuel Butler, something, between *bi* and *po!*" So it was finally agreed that he should be "Samuel Butler, philosophical writer"—*phi* agreeing properly with the order in which he had already been irrevocably pasted!

Now this long digression, by way of introduction, from the subject of my letter, has after all a definite significance in relation to it. It has indeed, for me, at least, a double significance. It suggests something about British ways and something about the doubt as to how Samuel Butler's writings, even the four books about Darwinism, Lamarckism and biological memory, should be classified. Are they contributions to science, or to pure literature? Certainly, they are contributions to the gaiety of nations when they are not, as occasionally they as certainly are, contributions to that which makes the judicious to grieve. Whatever of sharpness in polemic one may tolerate in a critic of Darwinism, innuendo and really almost scurrilous personal attack on Charles Darwin one will not tolerate. And Butler comes to no less than this in his attempt to show Darwin's bad faith in a matter of the use of a certain freely modified translation of an account of Erasmus Darwin by Krause, in *Kosmos*.

Butler, though strongly anti-Darwinian (that is, anti-natural selection and anti-Charles Darwin) is not anti-evolutionist. He professes, indeed, to be very much of an evolutionist, and in particular one who has taken it upon his shoulders to reinstate Buffon and Erasmus Darwin, and, as a follower of these two, Lamarck, in their rightful place as the most believable explainers of the factors and method of evolution. His evolution belief is a sort of Butlerized Lamarckism, tracing back originally to Buffon and Erasmus Darwin. He is equally insistent on degrading the explanations of Charles Darwin, Wallace and Weismann, viz., the selection

champions, to their rightfully ignoble place of puerility and imbecility. And finally he is intent on reestablishing the factor of design in evolution. He holds strongly to a certain sort of teleology in organic change. Organisms make themselves what they are somewhat understandingly, as it were. They know what is good for them, and try to do it and be it.

Granted, now, that this man is a master of epigram, paradox, sophistication, argument and audacity, and of a literary style as animated and sparkling as it is bold, and you can fancy that his books make interesting reading to professed students of evolution and to scientific men—at whom he sneers and laughs—as well as to those readers "whose time is worth money," whom he exalts and to whom he explicitly directs his writing.

The four books of this sort that were written originally some thirty years ago and that have been recently re-issued by Fifield in London and—I believe—Putnams in New York are: "Life and Habit" (1878), "Evolution, Old and New" (1879), "Unconscious Memory" (1880) and "Luck or Cunning" (1881). In 1890, in *The Universal Review* (London), he published three essays (really one in three parts) under the title "The Deadlock of Darwinism," in which he reiterates the general conclusions and theories set out in detail in his earlier writing.

In addition to these four books, offered as direct contributions to evolution discussion, a much earlier book, called "Erewhon" (=Nowhere) (1872), contains in its pages of fantastic picturing and imagination the budding thoughts that later form the basis of his anti-Darwinism. Particularly in the chapter called "The Book of the Machines" are his ideas of design and his denial of chance in world evolution set out. This book has had a wide diffusion, and is the one which really gave him literary repute. It is a picturesque account of the life and philosophy of the non-existent Erewhonians, and its pages reveal the imagination of a Wells and the satire of a Bernard Shaw. Shaw, indeed, has strongly commended it, and Augustine Birrell has called it the best satire since "Gulliver's Travels."

And I have not yet got to a word about "biological memory." Well, it will take but few sentences to point out Butler's relation to this subject. The fact that he used "Unconscious Memory" as title for one of his books shows the store he set by his notions about biological memory—notions that he undoubtedly developed independently, and that he believed, at the time he formulated them, to be wholly original with him. Butler's theory that heredity and instincts are the results of, or are themselves, biological memory, was set out in detail in his first biological book, "Life and Habit" (1878). The book "Unconscious Memory" (1880) is chiefly devoted to recording his discovery that he had been antedated by Ewald Hering, whose address on "Das Gedächtniss als allgemeine Funktion der organisirter Substanz," given before a meeting of the Vienna Imperial Academy of Sciences on May 30, 1870, he translates and prints in full. The book also contains a long translation from von Hartmann, and some discussion of it, to show that Hering's and Butler's theory of biological memory is not at all von Hartmann's unconscious control. And it is in this book, too, that Butler (Chap. IV.) says his worst about Darwin.

As a matter of fact, Hering was not the first to have the conception of an explanation of repetitive phenomena in organisms on the basis of cell or molecule memory. Lamarck and Haeckel had both suggested such an idea. In our own country, Cope and Hyatt, not earlier, but undoubtedly each originally, expressed the essence of such a conception. Hyatt indeed coined the word "mnemogenesis" for use in connection with his ideas about heredity and instinct. But Hering was certainly the first to give the conception full form, to compose it of details, and to suggest a physical basis for it, viz., the reception and storing by the body protoplasm of vibrations coming from without, so that this protoplasm became actually changed in capacity by its

various, and especially by its repeated, experiences.

Then came Butler, and, without knowledge of Hering's ideas, and out of a conviction that Darwin's natural selection of fortuitous variations was an absurd explanation of such fit things as instincts and hereditary repetitions, and that Lamarck's explanation of modification of individuals by effort and intent, carried over into racial acquirements by heredity, was a much better one but needed something else to make it complete, he re-invented the conception of biological memory and worked it out to its logical extreme. Just what this extreme is, and what the details of Butler's theory are, I leave to any of my readers interested to find out from Butler's books. For besides the interesting speculations of an intelligent and imaginative man about a subject that has, I am convinced, some real things in it to be found out some day, they will get from their perusal a gentle titillation of shock and amusement, such as the day's duty of "scientific reading" rarely brings.

Since Hering and Butler, have come, of course, Richard Semon with "Die Mneme" and its new, and perhaps useful, terminology for the older ideas, and lastly the blessing of Sir Francis Darwin on the whole idea, as well as on Butler himself, bestowed in his British Association President's address of 1908. But as it is Butler more than biological memory that this letter is meant to call attention to I may stop here. Butler died in 1902, and is only now coming to his hearing.

VERNON L. KELLOGG

LONDON,
February 24

THE DEATH OF NETTIE MARIA STEVENS

AT a meeting of the faculty of Bryn Mawr College, held May 6, 1912, it was voted to make the following record in the minutes:

WHEREAS, the faculty of Bryn Mawr College has heard with sincere sorrow of the death of Nettie Maria Stevens, A.B. and A.M. of Leland Stanford Junior University, graduate scholar in biology in Bryn Mawr College 1900–01, president's European fellow 1901–02, resident fellow in biology 1902–03, doctor of philosophy of this college in 1903, sometime research fellow in biology, Carnegie research assistant and Alice Freeman Palmer research fellow, and since 1904 as reader and then as associate in experimental morphology, a member of the teaching staff and of the faculty,

Resolved, that we, the faculty of Bryn Mawr College, desire to record our appreciation of her talent for research, of the skill and assiduity with which she carried on difficult investigations, achieving a success that placed her in the very front rank of students of science and gave her a world-wide reputation among workers in biology. No less would we recognize the faithfulness with which as a member of the faculty she responded to every call for her services in teaching or in any general work of the college. We deplore her loss. We honor her memory.

Resolved, that copies of these resolutions be sent to the relatives of Dr. Stevens, to the board of directors and to SCIENCE.

SCIENTIFIC NOTES AND NEWS

AT the suggestion of the German emperor, the Berlin Institute for Infectious Diseases will be named in honor of Robert Koch.

THE faculty, students and alumni of the university of California will erect in the museum corridor of the new agricultural hall of the University of California a bronze bust in honor of Dr. Eugene W. Hilgard, emeritus professor of agriculture.

PROFESSOR GRASSET, on the occasion of the thirtieth anniversary of his professorship of medicine at Montpelier, was presented with his bust and a medal.

PHYSICIANS of Philadelphia have been invited to join in honoring the memory of Dr. John Herr Musser by subscribing to the memorial fund to be used to endow the social service department of the University Hospital, Philadelphia, of which he was the founder and president. The will of Dr. Musser provides that if the personal estate reaches $240,000, the sum of $15,000 shall be given to the University of Pennsylvania for the endowment of a fellowship in honor of the late Dr. Robert M. Girvin.

THE new medical laboratories for the two years' course in medicine given at the Univer-

sity of North Carolina were opened on May 8. These laboratories present a complete equipment for anatomy, physiology, pathology, histology, pharmacology and the other studies usually included in the first two years' course. Provost Edgar F. Smith, of the University of Pennsylvania, delivered the chief address. The honorary degree of LL.D. was conferred upon Provost Smith, Dr. Charles W. Stiles, in charge of the work of the Rockefeller Hookworm Commission, and Dr. Richard H. Lewis, formerly secretary of the North Carolina Board of Health and president of the National Health Association.

Dr. W. P. Bradley, professor of chemistry at Wesleyan University, has been granted leave of absence for the year 1912–13, to organize a department of research for the United States Rubber Goods Company.

The American Philosophical Society has appointed the following delegates to represent it on the occasions designated: The Hon. Charlemagne Tower, at the inauguration of John Grier Hibben as president of Princeton University, on May 11; Dr. Morris Jastrow, Jr., at the fourth Congress on the History of Religions, to meet in Leyden on September 9–13 next; Professor Edward W. Morley, of West Hartford, Conn.; Professor Marston T. Bogert, of New York, and Professor Theo. William Richards, of Cambridge, at the eighth International Congress of Applied Chemistry, to be held in Washington and New York, September 4–13 next.

Dr. Franz Boas, professor of anthropology in Columbia University and in the University of Mexico, has returned to New York after a winter in Mexico and has immediately sailed for England to attend the Congress of Americanists to be held in London beginning on May 27.

Dr. George Byron Gordon, director of the University of Pennsylvania Museum, has been appointed a delegate to represent the university at the Eighteenth International Congress of Americanists.

Professor George H. Parker, Harvard University, gave the sixth lecture in the course offered to the students in the department of biology at Trinity College, on the evening of May 2 with the subject, "The Nervous System."

Mr. Talcott Williams, director of the School of Journalism of Columbia University, is giving the Phi Beta Kappa address at the universities of Wisconsin, Minnesota and Nebraska on May 6 to 9 on "The Old Learning and the New."

Professor Joseph Jastrow, of the University of Wisconsin, will give the commencement address at the Normal School, Emporia, Kansas, on June 5, and also addresses at the opening of the summer school there.

Professor Lillien J. Martin, of the psychological department of Stanford University, gave an address on "Ueber die Localisation optischer Vorstellungsbilder" at the Fifth Congress for Experimental Psychology, held in Berlin from April 16 to 19, 1912. Her address appears in full in the April number of the *Monatschrift für Psychiatrie und Neurologie.*

Special lectures will be given at Kings College, University of London, by Dr. F. W. Mott, F.R.S., on May 20, 27, June 3 and 10, on "Heredity considered from the Point of View of Physiology and Pathology."

There will be civil service examinations on June 5, for the position of agricultural propagator in the Philippine Service at a salary of $1,600; for examiners of surveys in the field service of the Department of Agriculture, at entrance salaries ranging from $1,200 to $1,500, and for scientific assistants, qualified in farm equipment, in the Bureau of Plant Industry, at salaries of $1,200 to $1,400.

The late Henry Iden bequeathed $100,000 to Cooper Union, New York City, and among other public bequests $10,000 each to the American Museum of Natural History, the New York Botanical Garden and the New York Zoological Society.

Two eggs of the Great Auk, as we learn from the London *Times,* were sold on April 17 at Mr. J. C. Stevens's rooms in King-

street, Covent Garden, the property of Lady Smyth, of Ashton Court, Somerset, who inherited them from the late Sir J. H. Greville Smyth. The finer of the two was purchased at an auction in Kent, and resold at Stevens's on April 24, 1894, for 180 guineas; it now brought 150 guineas. The second egg, which went for 140 guineas, was purchased with a number of sea-birds' eggs, many years ago, by the late owner, but nothing appears to be known of its earlier history. Both were bought by Mr. Ward. Sir J. H. Greville Smyth had another specimen of the egg (which was sold at Stevens's in 1888 for £225). This was presented by Lady Greville Smyth to the Bristol Museum. A "census" by Mr. Edward Bidwell, in connection with the Great Auk, shows that there are in existence and recorded 80 skins and 73 eggs.

THE Austrian government has purchased for about $600,000 the only two radium mines at Joachimsthal which were owned by private individuals. It is estimated that the two mines will yield annually about 3 grams of radium. Plans are under way for the development of Joachimsthal as a resort for the treatment of disease by radium.

A GIFT of $50,000 has been made by a donor who desires his name withheld for the purpose of furthering the work of the National Committee for Mental Hygiene. The same individual has agreed to give $50,000 more, on condition that the sum of $200,000 additional be secured. The *Journal* of the American Medical Association states that the purpose for which the committee was formed is the study of all matters connected with the commitment, care and after-treatment of the insane. Plans for the study of this subject have been carefully prepared, and it is intended to encourage the formation in the various states of allied but independent societies with similar aims to those of the national committee. A special subcommittee, of which Dr. William L. Russell, superintendent of the Bloomingdale Hospital, is chairman, has been formed to begin the work outlined, and an office has been opened in the Germania Life Building, New York City. Dr. Thomas W. Salmon, of the United States Public Health and Marine-Hospital Service, has been granted leave of absence by the government to undertake this work and has been engaged to conduct the studies outlined by the committee. The newly elected officers are: president, Dr. Llewellys F. Barker, of Johns Hopkins University; vice-presidents, Dr. William H. Welch, of Johns Hopkins Medical School; Dr. Charles P. Bancroft, superintendent of the New Hampshire State Hospital, Concord, N. H.; treasurer, Otto T. Bannard, president of the New York Trust Company; chairman of the executive committee, Dr. George Blumer, dean of Yale Medical School; chairman of the finance committee, Professor Russell H. Chittenden, director of Sheffield Scientific School of Yale University; secretary, Clifford W. Beers, organizer of the National Committee for Mental Hygiene.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Charles Herbert Pratt, the Massachusetts Institute of Technology receives a large bequest to endow a Pratt school of naval architecture and marine engineering. The income of the estate is to accumulate until the sum of $750,000 has been reached, though it may be used at the expiration of twenty-one years.

GOVERNOR Foss has signed the bill passed by the Massachusetts legislature appropriating $50,000 annually for five years to the Worcester Polytechnic Institute. The grant is to be extended for an additional five years if in the meantime the institute obtains $350,000.

AN anonymous benefactor has given $100,000 to Hamilton College for the erection of a new library building.

COLUMBIA UNIVERSITY has received from Mr. and Mrs. William R. Peters a gift of $50,000 to establish a fund for engineering research in memory of their son William R. Peters, Jr.

A SECOND gift of $25,000 to Brown University from Mr. John D. Rockefeller, Jr., is

announced. The endowment has now reached $815,000 toward the desired million dollars.

Appropriation bills for the College of Agriculture, Cornell University, to the amount of $907,000, of which $788,000 is immediately available, were passed by the New York legislature at its recent session and signed by Governor Dix. The Veterinary College received an appropriation of $105,000, bringing the total up to $1,012,000. Of the appropriation $329,000 is for the erection of new buildings for the use of the departments of forestry, agronomy and animal husbandry; $129,000 of this amount is not immediately available. There was reappropriated $182,000 for the completion of work already under way; $265,000 for the current expenses of the college, and $141,000 in what is known as the supply bill.

The Johns Hopkins School of Technology will be opened next fall, offering instruction in three branches, mechanical and electrical engineering and applied chemistry. A committee headed by Mr. R. Brent Keyser, president of the board of trustees, Dr. J. S. Ames, director of the physical laboratory, and Dr. William B. Clark, professor of geology, has made a trip to the educational centers of the north, where they consulted with a number of educators on plans for organizing the instition.

Dr. John Grier Hibben, hitherto Stuart professor of logic, was installed as president of Princeton University on May 11. There were present President Taft, Chief Justice White and delegates from one hundred and seventy-one educational institutions. The oath of office was administered by Justice Pitney, and President Hibben made an inaugural address on the essentials of a liberal education. Degrees were conferred on President Taft and Chief Justice White. At the luncheon speeches were made by them and by ex-President Patton, of Princeton; President Lowell, of Harvard; President Hadley, of Yale; President Butler, of Columbia, and President Schurman, of Cornell.

Dr. David L. Edsall has been elected to the Jackson professorship of clinical medicine in the Harvard Medical School to fill the vacancy made by the resignation of Dr. Frederick C. Shattuck, under the retiring rules of the Massachusetts General Hospital. At the same time Dr. Edsall has been appointed to one of the two permanent medical services at that hospital. He is a graduate of Princeton and of the University of Pennsylvania Medical School. He was professor in that school until 1910, and since in the Medical School of Washington University, St. Louis.

The trustees of Cornell University have made appointments and promotions as follows: C. G. Woodbury, professor of pomology; Hugh Charles Troy, professor of dairy industry. The following assistant professors were promoted to the rank of professor: J. A. Bizzell, in soil technology; W. A. Riley, in entomology; G. W. Herrick, in entomology; H. W. Riley, in farm mechanics, and H. E. Ross, in dairy industry. The following instructors were promoted to the rank of assistant professor: L. J. Cross, in agricultural chemistry; Robert Matheson, in entomology; George C. Embody, in entomology; Arthur L. Thompson, in farm management, and Ralph H. Wheeler, in extension teaching. Albert Edward Wells, superintendent of shops of Sibley College, was appointed assistant professor of machine design.

John Harland Kelson, head of the department of applied mechanics at Case School of Applied Science, Cleveland, Ohio, has been elected professor of applied mechanics at the Worcester Polytechnic Institute, succeeding the late Professor E. B. Hancock.

There have been appointed in the School of Journalism of Columbia University, Dr. E. E. Slossen, of the editorial staff of *The Independent*, formerly professor of chemistry in the University of Wyoming, as associate, and Dr. Walter B. Pitkin, of the department of philosophy of the university, as associate professor.

At the University of Wisconsin, Dr. James B. Overton has been promoted from assistant professor of botany to associate professor of plant physiology, and Mr. Gilbert M. Smith

from assistant in botany to instructor in botany.

MR. E. N. ZERN, professor of coal mining at the University of Pittsburgh, has been recently appointed professor of mining engineering at the West Virginia University. Mr. George Grow has also been made assistant in the College of Engineering at the same institution.

HENRY LEIGHTON, formerly instructor in the school of mines, University of Pittsburgh, has been advanced to be assistant professor of economic geology, in charge of the departments of economic geology and ceramics.

MR. J. W. COBB, B.Sc., has been appointed to succeed Dr. Bone, F.R.S., as Livesey professor of coal gas and fuel industries at Leeds University.

DISCUSSION AND CORRESPONDENCE

THE OCCURRENCE OF STIBNITE AT STEAMBOAT SPRINGS, NEVADA

STEAMBOAT SPRINGS, Nevada, has been often cited as an example of a metalliferous deposit in the process of formation. Becker[1] demonstrated the presence of metallic sulphides in the waters flowing from the springs and described their occurrence in an amorphous condition in the spring deposits. He was unable, however, to find any of the sulphide minerals crystallized. Some years later Lindgren[2] announced the discovery of minute crystals of pyrite and stibnite in sand and gravel that had been brought up from the bottom of a prospect shaft penetrating the sinter. It was evident from the mode of crystallization of these minerals that they had been deposited from the heated waters of the springs.

During a recent visit to the springs a grayish mud was noted in the bottom of several pools at the northern end of the sinter terrace, about a half mile from the station. On examination under a microscope it was seen that minute acicular crystals of stibnite made up a large proportion of the mud. These were usually very thin and, when perfect, shaped like the blade of a Roman sword with parallel edges and blunt point. The crystals were too minute for accurate measurement, but the forms observed were probably the brachy- and macro-pinacoids and a macrodome. The larger crystals were frequently split towards one end into a narrow fan of finer blades and many individual crystals were bent and curved. Usually the stibnite was segregated in felted balls and occasionally completely surrounded microscopic grains of sand, which had served as nuclei for the forming crystals.

The remainder of the mud was made up of diatom skeletons, fragments of chalcedonic quartz, kaolinized feldspar, and occasional flakes of mica and hornblende.

The water in the pools is very clear and limpid, with the exception of one unusually active spring where the suspended sediment is sufficient to make the water turbid. The temperature of the water in the pools in which stibnite was found ranged from 86° C. to 93° C., and averaged somewhat higher than that of the pools at the southern end of the terrace where the antimony sulphide is deposited as an amorphous precipitate.

Clark[3] cites the experiments of Doelter showing that stibnite is soluble in water heated to 80° C., especially in the presence of sodium sulphide. Melville's[4] analyses of the water of Steamboat Springs show sodium sulphide to be present. As the temperature of the springs in which stibnite was found is above that in Doelter's experiments, it is probable that the crystallization of the stibnite takes place as the heated waters approach the surface.

The complete envelopment of sand grains by the stibnite crystals presupposes free suspension in the water during the period of crystallization. The rounded form of the balls of felted crystals suggests that they formed under similar conditions. It is not unlikely that the stibnite crystallizes in the

[1] Mon. U. S. Geol. Survey, Vol. 13, 1888, pp. 342–344.

[2] *Trans. A. I. M. E.*, Vol. 36, 1906, pp. 27–31.

[3] "Data of Geochemistry," U. S. G. S. Bull. 491, 1911, p. 603.

[4] Mon. U. S. Geol. Survey, Vol. 13, 1888, pp. 347, 349.

pool and is kept in suspension by the constant agitation of the rising water.

The formation of one of the minerals associated with ore deposits under conditions that may be observed is of more than passing interest and a closer study is in progress.

J Claude Jones

Mackay School of Mines,
Reno, Nevada

CERIUM

If any mineral collection contains specimens of cerium ochre or yttrocerite from Bolton or any other Massachusetts locality, I should be obliged to the curator of such collection if he would inform me of the fact and give me briefly the history and description of the specimen.

B. K. Emerson

Amherst, Mass.

POPULARIZING SCIENCES

Thirty years ago the incorporated city of San Diego, California, possessed a population of perhaps two thousand. Clergymen, lawyers, teachers, business men, working men, were alike members of the Society of Natural History, and its president, a physician, kept up the interest in the monthly meetings. Everybody came, bringing a rock or a shell or a bird or some object curious or rare, contributing to the little museum, and arousing discussion.

To-day a six-story concrete building is being erected on a lot given to the society for a home, one floor to be used for its museum and library, the other floors forming part of a hotel. With a present population of near 50,000, annual meetings are held by the society, which are generally attended by barely enough members for the election of officers. The library and museum are at a standstill. The meteorological records, begun by the society's president, are continued by a fully equipped station of the weather bureau of the U. S. Department of Agriculture—of which we sometimes hear boastful but seldom instructive remarks.

A marine biological station has been established, under control of the state university, and given $50,000 for a building—but the public rarely hears of any results, except of the occasional visit of some noted scientist, as heralded in the dailies.

A floral society now exists, and a botanical garden is proposed, to which nurserymen will sometime be invited to contribute from their commercial stock, but no strictly botanical work is in progress in the community, and the only attempt in fifteen years met with failure for lack of appreciation.

The city contains three private collections of shells, one of insects, one of birds, one or two of minerals, two botanists without herbaria, one meteorologist (in government employ), and a few others interested inactively in some phase of science, or about one naturalist to each five thousand people, which I have seen stated to be about the average number in the United States.

I recently visited one of the nearby grand ocean beaches, where the sea still breaks in spray over the rocks, as it did thirty years ago—but the pools that formerly concealed a wealth of beautiful wonders in animal and plant life have been scraped clean of their former treasures. Now and then a crab scuttles to safety. A hook and line sometimes brings one of the finny tribe from the deep—but boys and girls can hunt in vain for the many nature treasures that formerly lined the shores of ocean and nearby bay.

Children may still reap a treasure in wild flowers in springtime—by taking generous car rides and then walking—but they will look in vain in our paved streets for the trap-door spider's nest that I formerly watched, or for the miniature plants like the lichens that formerly freely decorated barren spots of earth.

With the increased cost of living, with leaps and bounds in the growth of our commercial life, with a corner lot that cost $5,000 ten years ago now yielding an annual rental of $6,000 to its purchaser, can you expect to find nature study gaining ground!

Science as a study is becoming too complicated for a layman to take part in the active

fashion of former times, and it is becoming yearly more expensive and difficult for one in private life to keep abreast of the times even by specializing in a restricted field.

And opportunities for one to do good scientific work with any chance of earning expense money are exceeding rare—unless a salaried position is secured in advance.

The increased number of scientific and educational institutions apparently fail to give equal facilities with the past to the independent youthful student. And the increase in volume of literature renders it impossible for any one not connected with some wealthy institution, or with large private means, to keep posted on proposed changes in nomenclature —to say nothing of the new discoveries being made.

There is no decrease in the interest of the general public in scientific work, but the existing state of affairs is probably due chiefly to expansion and greatly increased activity, resulting in a mass of unassimilated data and museums bursting beyond the bounds set by their founders.

C. R. ORCUTT

SCIENTIFIC BOOKS

A Cyclopedia of American Medical Biography, Comprising the Lives of Eminent Deceased Physicians and Surgeons from 1610 to 1910. By HOWARD A. KELLY, M.D. Illustrated with Portraits. Two Volumes. Philadelphia and London, W. B. Saunders Company. 1912.

This work, handsome in typography and execution, and containing over twelve hundred biographies of prominent deceased American physicians, written, for the most part, in clean-cut style by various competent hands, marks a distinct advance upon any of its predecessors in the same kind. Of the earlier dictionaries of American medical biography, those of Thacher (1828) and of the eminent surgeon S. D. Gross (1861) have a definite historic value, but the separate lives are usually too long, Thacher's, in particular, being surcharged with that florid, stilted spirit which, as Dr. Holmes wittily said, "has chewed the juice out of all the superlatives in the language in Fourth of July orations"; while the generous-minded Gross, incapable of saying anything unkind about his colleagues, was perhaps lacking in a right critical sense for that very reason. On the other hand, the later works—those of Atkinson (1878), Stone (1894) and Watson (1896) —abound in shorter biographies, but are, in the main, only directories of contemporary names. Dr. Kelly's Cyclopedia strikes a happy balance between the extremes of florid encomium and mediocre choice, consisting, in the main, of compact sketches of the lives of medical men who have "done things," and is thus a genuine contribution to medical history. Some of these worthies have described new diseases, have introduced new drugs, new operations or therapeutic procedures, or have otherwise contributed to the elevation of American medicine as chemists, botanists, zoologists, bibliophiles, military and naval surgeons or leaders in hygienic and social movements. The editor's plan in getting up this work was two-fold: one group of his coworkers took up the physicians who were of local importance as practitioners; the other group took care of those who are of scientific importance in relation to the specialties which they helped to advance. Some of the former class might seem at first sight of little consequence, yet it will appear that as teachers, organizers of schools and hospitals, pioneers in hygiene, whether in Canada, Mississippi or the far west, they have their place in the development of earlier American medicine, even though unknown in Berlin, St. Petersburg or Vienna. Professor Horatio C. Wood, the well-known therapeutist, relates that he was once asked by an eminent European authority for a list of the professors of his specialty in America. Upon receiving some forty or fifty names, the astounded savant replied: "In God's name who are these people? I never heard of more than one or two of them."[1] Identical sensations are experienced in looking over the pages of Hirsch's "Biographisches Lexikon der Aerzte," that monument of

[1] *Therap. Gaz.*, Detroit, 1911, XXXV., 92.

German industry, especially when we come to the Meyers, Müllers, Schmidts and Schmitts. In other words, many able physicians are of that exclusively local importance so well described in Sainte Beuve's famous reply to Matthew Arnold: "He was important to *us*."

The introduction to this Cyclopedia consists of a series of valuable historical sketches on the development of different branches of medical science in America, notably those of Dr. Charles R. Bardeen on anatomy, Dr. Martin B. Tinker on surgery, and the histories of gynecology and obstetrics by Dr. Kelly himself. Few specialists seem to know or care so little about the history of their subject as gynecologists, probably because its development has been mainly technical and instrumental. In this regard, Dr. Kelly's sketch may be pronounced the best history of American gynecology that has yet appeared. It is memorable that operative gynecology, which had no existence as a specialty before the nineteenth century, is largely of American origin—in the first instance, an expedient to repair the sequels of backwoods obstetrics, and that its principal founders—McDowell, Marion Sims, Battey, Nott, Emmet, Bozeman, Gaillard Thomas—have been natives of the southern states.

Of especial historical interest are the notices of the colonial pamphleteers on smallpox and vaccination, the eighteenth century leaders (Rush, Morgan, Shippen, Physick), the pioneers in the surgery of the vascular system and the joints, the discoverers and exploiters of surgical anesthesia, the medical botanists, the medical jurisconsults, the important physicians of the Philadelphia group, and such later worthies as William Pepper, Walter Reed, Nicholas Senn or Elizabeth Blackwell. A biography of Hezekiah Beardsley, who, in 1788, described congenital hypertrophic stenosis of the pylorus, appears for the first time. There have been some omissions, perhaps unavoidable in works of this kind, in particular, Bowditch the physiologist, Bigelow the surgeon and the clinicians James Jackson and John K. Mitchell. Of John C. Otto, of Philadelphia, who, in 1803, first described hemophilia,[2] perhaps "*Non dat quod non habet.*" It is doubtful if Ricord and Brown Séquard can properly be included among Americans, since both were of French origin and all their life-work was identified with French medicine. On similar grounds, the omission of William Charles Wells, of South Carolina, memorable to physicists for his "Essay on Dew," seems not improper. A few points in priority in Dr. Tinker's surgical introduction may be noted. It is frequently asserted that Dr. Dixi Crosby, of New Hampshire, was the first to perform the inter-scapular-thoracic amputation (excision of arm, scapula and clavicle) in 1836. It had already been performed by Ralph Cuming, an English naval surgeon, in 1808.[3] Dupuytren cured a popliteal aneurism by compression in 1818,[4] long before Jonathan Knight (1845) or O'Bryen Bellingham (1847), although Knight is undoubtedly entitled to the credit of doing this by digital compression. If Dr. Heine Marks really sutured a wounded heart before Farina and the Italian surgeons, it remains for him to prove it, as he mentions not a stitch of it in his published paper.

These volumes are embellished with many interesting portraits, those of Asa Gray, Fordyce Barker, Dewees, Agnew, Senn and Leidy being particularly good, while those of John Morgan, Physick, Horner (of Horner's muscle), Caspar Wistar, J. P. Mettauer and Willard Parker are probably copied for the first time. Many of the biographies have preserved traits of eccentricity in medical men who happened to be oddfish, more especially those from the piquant pen of Miss Davina Waterson. The following sentences of Joseph Leidy on introducing himself before a lecture are an example of the utter freedom from swagger and snobbery which distinguishes the true man of science:

> My name is Joseph Leidy, doctor of medicine. I was born in this city the ninth of September, 1823, and have lived here ever since. My father

[2] *Med. Repository*, New York, 1803, VI., 1–4.
[3] *Lond. M. Gaz.*, 1829–30, V., 273.
[4] *Bull. Fac. de méd. de Par.*, 1818, VI., 242.
[5] *Med. Fortnightly*, St. Louis, 1893, III., 44–46.

was Philip Leidy, the hatter, on 3rd street above Vine; my mother, Katherine Mellick, but she died a few months after my birth, and my father married her sister Cristina, who was all in all to me, the one to whom I owe all that I am. At an early age I took great delight in natural history, of which I have reason to think I know a little, and a little of that little I propose to teach you to-night.

One does not need to glance at the splendid head on the opposite page to realize that this great naturalist, whose "Rhizopods of North America," is one of our finest biological classics, was *echt,* in the exquisite Emersonian sense of living "from a great depth of being."

There are a few typographical errors here and there, but these things are of little consequence in a work which deserves to be in the library of every physician interested in the medical history of his country, and which will undoubtedly prove a valuable reference book in working scientific and public libraries.

F. H. GARRISON
SURGEON GENERAL'S LIBRARY

A Revision of the Cotylosauria of North America. By E. C. CASE. Washington, Carnegie Institution, Publication No. 145. 1911. Pp. 122, 14 plates.

It is now more than thirty-six years since the first Permian or Permo-Carboniferous reptiles were made known from North America by the late Professor Cope, who until his death twenty years or more later published at frequent intervals papers dealing with Paleozoic land vertebrates, coming chiefly from the famous deposits in northern Texas. As a pioneer, his work, here as elsewhere, was, of necessity, largely based upon fragmentary and imperfect material, material largely obscured by an obdurate matrix that only long and skilful preparation could remove. Few, if any, forms were known to him in anything approaching perfection or even completeness. As an inevitable result he left the subject in more or less confusion, notwithstanding the many important facts which he discovered. Many of his types were never figured nor even adequately described. In more recent years, beginning with Professor Case's collection in Texas in 1897, the additions to our knowledge of these old land vertebrates made by him and others have been very considerable and of profound importance in paleontology. But much of the confusion and doubt regarding many of the original types, for the most part preserved in the American Museum of New York City, could only be removed by a careful revision of the whole group, based upon original specimens. This Professor Case has given us of the so-called order Cotylosauria in the present paper. At the present time there is, perhaps, no group of vertebrates of deeper interest to the student of evolution than the primitive reptiles and amphibians of the later Paleozoic, the forms from which all later vertebrates, save the fishes, have been derived. The many problems of the evolution of the Amphibia, and the origin and "radiation" of the Reptilia, are, until other fields have been discovered, dependent chiefly if not almost wholly on the Permo-Carboniferous deposits of Texas and the Rocky Mountains. No classification of the reptiles and amphibians will ever command any great degree of respect until these faunas have been well worked out; and, inasmuch as many of the problems of these groups are fundamental ones in many respects for all higher vertebrates, the interest attached to such studies as the present may be easily understood.

Professor Case did a very acceptable piece of work in his revision of the Pelycosauria, or the higher reptiles of the same fauna, published a few years ago. In the present work he has revised systematically and morphologically the numerous genera and species that have been proposed of the cotylosaurian reptiles, a group usually called an order though not distinguishable by very important characters from the Pelycosauria or Theromorpha. The chief value of the paper is the information given of the fragmentary and often unrecognizable types of Cope, as interpreted in the light of a more advanced knowledge of the group, by descriptions, comparisons and illustrations. Not much new material has been described nor have many new forms been added that had not been published by himself

or others previously. He divides the order into four suborders, the Pareiasauria, Procolophonia, Diadectosauria and Pantylosauria, the last two new. While these terms will be convenient, the present writer doubts whether the distribution proposed of the families is really the best, or whether indeed there is really any need of classificatory terms between the family and order at present.

Dr. Case urges, what has now become apparent, that the Cotylosauria are far from being the beginning of the reptilian stem, that forms so diverse as those we already know from the base of the American Permian must have been long years in developing. Nevertheless they approach that beginning relatively close, and, until the actual beginning is found, must suffice as the basis for the classification of all later reptiles. The writer can not agree with the author in the interpretation of some of the cranial elements in these reptiles, but as that is a subject about which no two authors agree, Dr. Case's views are perhaps as good as those of others. Nor is he assured that the forms *Eosauravus* and *Sauravus* really belong among the Cotylosauria. And, as regards the attachment of the ribs in these "microsaurian" forms, they are really not different from those of all the known Permo-Carboniferous reptiles.

The work has been brought out in excellent shape by the Carnegie Institution, and it will long remain as an indispensable one for all students of the early reptiles.

S. W. Williston

The Home-life of the Osprey. By Clinton G. Abbott. London, Witherby & Co. 1911. Pp. 1–56; 32 mounted plates.

This volume forms the third of an admirably planned series, designed to present, through the aid of pictures and a brief text, the most interesting facts about celebrities of the bird world. The American osprey is worthy of this distinction, and the field-work, upon which this biography is based, although "necessarily limited to the brief opportunities of a business man," has been prepared with commendable care. We venture to express the hope that more business men, and representatives of the professions may in time come to reap the profits and enjoyments which an intelligent interest in natural history affords.

The author's studies were made on the coast of New Jersey, at Great Lake, North Carolina, and at that world-famous preserve for ospreys, Gardiner's Island, New York. This tract of 3,000 acres is three miles from the eastern end of Long Island, and is probably unique in that, as we are told, it has been in the possession of the same family for nearly 300 years, or since the time of its purchase from the Indians for "ten coats of trading cloath." It is now maintained as a general farm and preserve, with "a pleasing succession of rolling meadows, thick coverts, stately trees, lakes and grassy marshes." This remarkable island has been the immemorial home of fish hawks, and is now thought to harbor upwards of 200 of their massive nests. Moreover, these gigantic structures are reared with absolute freedom, in almost every conceivable situation, upon the shifting sands of the beach, upon great rocks, in trees or even upon the gable end of a deserted barn or shed. The author shows a nest built on a fence-post and another on a telegraph pole, while in parts of Connecticut these neighborly birds have often taken kindly to the old cart wheel reared aloft for their special benefit on the top of a high pole.

Ospreys are model parents, friendly to man, and exceedingly attractive at all times. Many characteristic attitudes in both young and adult are described and figured by Mr. Abbott, such as flying up the wind in returning to the nest, detouring, repeating and often alighting on any favorite perch other than the nest. Like other birds, they hold closely to the perch, upon which habit has fixed.

Mr. Abbott never saw the parents sprinkle their young with water, but Allen, an earlier observer of this species, found that they occasionally brought fresh seaweed to their eyrie. "Similarly, I have sincere doubts," says the writer, whether the "grateful shade, over the young, of the parent's outstretched wings, is not more accidental than inten-

tional." As a result of long observation we know that shielding is a common practise with nesting birds. It is probably something more than a heat-reflex, since it is most characteristic of the later period of nest-life, when it succeeds the more familiar brooding "habit." This spreading over the young, or shielding attitude, is useful like the other instincts, but whether it is "intentional" or not is quite aside from the main question. We might even have to qualify any sweeping statement that *brooding* was intentional. "Spreading," when away from the nest, is undoubtedly a reflex, and is often apparently due to heat, but birds will spread in a similar manner to dry off when wet.

Young ospreys are fed at long intervals, not oftener than twice or three times a day, though the rate of feeding possibly may vary somewhat with age. At one nest which the author carefully watched, meals were served at 7 P.M. and at 4.15 A.M. and 7 P.M. on the following day. At night the male guards the nest, while its mate broods.

The osprey is said by fishermen to descend four or five feet in the water to strike the flounder, which is often seen in its talons. Fish are always carried head foremost, either the bird's right or left foot being directed forward. It will be interesting to note that the largest capture which Audubon directly observed, was a weak-fish, weighing upwards of five pounds. This bird, he remarked, was barely able to rise from the water, and when shot at it immediately dropped its quarry. Moreover, it was this large and perfect specimen which Audubon introduced into his plate.

Nest-building begins in May and additions to the structure are made throughout the season. A nest once built and occupied is commonly held as a rightful and individual possession, and the structure tends to increase in bulk from year to year. The writer, however, finds that this is not invariably the case, and much more exact knowledge on the history of such nests is greatly needed. A nest of the osprey which was removed from Gardiner's Island to the New York Zoological Garden weighed 400 pounds and it is thought that the largest nests may even reach the weight of half a ton. At this island the eggs are laid early in May, and two to three in number. Incubation lasts from 24 to 28 days, the young ospreys emerging in close furry down. Nest-life lasts from 5 to 6 weeks, and is over by early August.

We do not for a moment believe that ospreys or any other wild birds suffer the "mental anguish" about their young which the writer generously attributes to them, but we are not disposed to be overexacting with work conscientiously done, and especially when a good moral lesson is enforced.

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A Text-book of Botany for Colleges and Universities. By members of the Botanical Staff of the University of Chicago, JOHN MERLE COULTER, Ph.D., Professor of Plant Morphology; CHARLES REID BARNES, Ph.D., Late Professor of Plant Physiology; HENRY CHANDLER COWLES, Ph.D., Associate Professor of Plant Ecology. Vol. II. Ecology. New York, Cincinnati and Chicago. American Book Company, octavo. Pp. x + 485 to 964 + 17.

A little more than a year ago the present writer noticed the first volume (Parts I. and II.) of this notable contribution to the American text-books of botany (SCIENCE, January 6, 1911), and suggested the probable early appearance of Part III. This saw the light about the holidays, and has been before the botanists of the country long enough to have already taken its place as one of the standard texts in its special department of botany. No doubt the first feeling of every botanist was one of surprise at the quite different mode of treatment given to the subject from that which has heretofore been accorded it. Some things hitherto regarded as ecological are entirely left out in Dr. Cowles's treatment or given very little emphasis. No doubt many an "ecologist" will rub his eyes as he looks about him in certain chapters for something familiar.

In an introductory chapter the author discusses his problem in such manner as to help us to see it from his point of view, starting with the remark that "ecology is a science in its beginnings." A little later he says "nor is it possible as yet to mark out its limits, for it overlaps to a greater or less degree every other field of biology and of physiography and geology as well." In spite of these difficulties he ventures a definition of ecology as "that phase of biology that endeavors to explain the origin, variation and rôle of plant or animal structures, and the origin and variation of plant or animal associations." This introductory chapter ought in fact to be very carefully read and reread by the student who wishes to know what it is that Dr. Cowles is putting before him under the name "ecology," for it will be evident very early in the use of the book that it is not at all like those that have preceded it, which means that this "ecology" is not the "ecology" of many other authors.

The general plan of the book may be seen in an enumeration of the contents of the eight chapters, as follows: (I.) Roots and Rhizoids; (II.) Leaves; (III.) Stems; (IV.) Saprophytisms and Symbiosis; (V.) Reproduction and Dispersal; (VI.) Germination; (VII.) Plant Associations; (VIII.) Adaptation. If now the student will read carefully any of these chapters he will find that they deal almost entirely with structure and behavior, and it appears to be the author's deliberate purpose to present these as the material upon which the beginner in ecology is to work. That is, Dr. Cowles bases ecology upon morphology and physiology, just as some of us have been insisting for these past years during which a certain type of ecologists were leading wholly unprepared young people into hazy observations in the field.

It is noticeable that the author has pretty fully eliminated teleology, which had become so conspicuous in the ecological writings of some botanists, reminding one in extreme cases of the botany of the early part of the nineteenth century. This revival of teleology by the younger generation was not a little disquieting to the older botanists, who rightly felt that it was a backward step in the science to return to a view or doctrine that had only so recently been abandoned. In Dr. Cowles's book there is no conscious leaning toward teleology, and for this scientific men owe him a debt of gratitude.

In like manner the author has subordinated the geographical phases of the subject, giving some portions scant notice. He has chosen to emphasize the plant individually, rather than the mass of individuals constituting a particular community of plants. This no doubt contributes to clearness and definiteness and there can be no question that the students who approach ecological studies from this side and in this manner will have much more lucid notions on the subject than those who were taken directly into the field for the study of "vegetation" and "formations." It will be interesting to see what effect this presentation of ecology will have upon its study in high schools and the smaller colleges, where too often it had degenerated into vapid lectures on the general aspects of the vegetational landscape much after the fashion of those formerly given to young ladies who "took botany" in the old-time female seminaries of a century ago.

One of the most helpful and suggestive chapters is that on Saphrophytism and Symbiosis (IV.), dealing as it does with all phases of the structural and physiological relation of the two organisms concerned. The treatment here is clear, and well calculated to lay a solid foundation in the mind of the beginner.

In the fifth chapter (Reproduction and Dispersal), while by far the greatest attention is given to these phenomena in the flowering plants, the subject is introduced by twenty pages on the behavior of the lower plants, the author's idea evidently being that even lower plants are worth while ecologically, especially as they are simpler and more easily understood. The treatment throughout the chapter has an air of freshness that is gratifying, much of the matter having been developed by the author in connection with his class work.

The short chapter on plant associations,

eight pages in all, will be disappointing to old-time ecologists, to whom, however, its brevity should be a suggestion that they have hitherto given overmuch emphasis to this phase of the subject.

A thoughtful chapter on "adaptation," in which the author gives his personal views on the subject, closes the book in such a manner as to leave the student in a properly humble state of mind, since it makes it clear that many of the "cock sure" conclusions of yesterday are improbable, or quite impossible.

A most useful, ten-page appendix contains a classified bibliography which will prove very useful to the student who wishes to go farther than the study suggested in the text.

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SPECIAL ARTICLES

THE PHOTOELECTRIC EFFECT

READERS of SCIENCE may be interested in the following brief summary of some of the principal results of an investigation of the magnitude and distribution of the total kinetic energy of the electrons emitted when light falls on metals, considered as a function of the frequency of the light and of the nature of the metal. A fuller account of the investigation was communicated to the meeting of the American Physical Society at Boston on April 27.

Monochromatic ultraviolet light of various wave-lengths from a quartz-mercury arc lamp was allowed to fall on a small strip of the metal to be tested placed at the center of an exhausted conducting sphere. Measurements of the currents against various opposing potentials enable the distribution of the energy among the emitted electrons to be obtained directly. The experimental results may be analyzed and exhibited graphically by plotting the number of electrons having a given energy against the energy. These curves are nearly symmetrical about the axis of mean energy. The mean energy is very close to the most probable value of the energy. The probability of an electron having energy within a given range changes very rapidly in the neighborhood, both of the maximum energy and of zero energy. The maximum energy, and also the range of energy, of the electrons emitted by light of a given frequency is approximately a linear function of the frequency.

For different substances the relation between the mean energy T_v and the frequency v of the exciting light is found to be $T_v = k_1(v - v_0)$. For sodium, magnesium, zinc, aluminium, tin and platinum $k_1 = 2.9 \times 10^{-27}$ erg. sec. v_0 is a constant characteristic of the substance. The above formula is a particular case of a more general relation $T_v = v\phi(v_0/v)$, where ϕ is a universal function of the argument, which was deduced theoretically by one of the writers. According to the theory the values of v_0 should be calculable from Planck's radiation constant h and the intrinsic potentials of the substances. The calculated values of $\lambda_0 = c/v_0$ are compared with those given by the photoelectric measurements in the following table:

	Na	Al	Mg	Zn	Sn	Bi	Cu	Pt
λ_0 (calculated)....	52.6	36.0	34.6	33.3	31.0	29.4	28.0	27.3
λ_0 (photoelectric)	57.0	39.5	36.5	36.1	33.8	33.1	29.7	29.0

Our measurements of the maximum energy T_m are probably less accurate and certainly more irregular than those of the mean energy; but they are all fairly near the linear relation $T_m = k_2(v - v_0)$. The values of v_0 are the same as before and k_2 is very near to 6×10^{-27} erg. sec. k_2 is thus about 10 per cent. less than Planck's constant h. We do not, however, wish to emphasize this difference, pending further investigation, as we realize that the accurate measurement of the maximum energy is a rather difficult problem. Bismuth and copper appear to have smaller values of both k_1 and k_2 than the other metals, but here again it is possible that further research will remove the difference.

If the laws which we have found to connect the frequency of the light with the maximum and mean energy of the liberated electrons hold up to the highest frequencies, it follows

that the frequency v of Röntgen rays may be obtained from either of the equations

$$v - v_0 = \frac{T_v}{2.9} \times 10^{27} = \frac{T_m}{6} \times 10^{27},$$

where T_v is the mean energy and T_m the maximum energy of the electrons emitted when Röntgen rays fall on a metal. For these high frequencies v_0 may be neglected compared with v.

Our results are favorable to a theory of the photoelectric effect of the type of Einstein's[1] combined with the hypothesis that the difference in the work P for different substances is determined by the contact difference of potential.

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Karl T. Compton

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Preliminary Note on the Occurrence of a Sex-Limited Character in Cats[1]

The problems offered by so-called "sex-limited characters" have lately been attacked by several investigators who have found in many of the cases a possible explanation of the observed phenomena by considering one of the sexes a Mendelian homozygote for the "sex-producing" factor, while the other sex is considered a heterozygote.

The sex-producing factor is commonly designated by X, its absence by —. Thus one sex would be homozygous, XX, and the other would be heterozygous, X —. Certain cases have been found in which experimental results indicate that the female is homozygous, XX, while the male is heterozygous, X —, while in other cases the facts are best explained on the hypothesis that the female is heterozygous, the male homozygous. Interest increases as sex-limited characters are found in the higher animals, the inheritance of which follows one or the other of these formulæ.

It has long been known that "tortoise shell" (a blotching of black and yellow, or blue and cream) occurs in cats, in a vast majority of cases in the female sex. Doncaster[2] (1904) attempted to ascertain whether tortoise shell could be considered as a sex-limited character whose appearance conformed to the then existing hypotheses of sex-inheritance. He came to the conclusion that "tortoise" was merely the female form of heterozygote obtained in a cross between orange (yellow) and black animals. The male form of "heterozygote" was orange in certain crosses. Thus he found that (1) orange female × black male gives tortoise females and *orange* males, but the reciprocal cross (2) black female × orange male gives tortoise, *black* (and probably orange) sexes not stated. This last-named cross is crucial, for in it is contained the evidence that the male "heterozygotes" between orange and black are *not always orange, but may be black.* The writer has, in a very small way, carried on this cross. Thus four black females crossed with the same orange male have given a total of 15 young; of these 7 were males, *all being black,* and 8 were females, *all being tortoise; no "orange" animals appeared.* Here there is evidence that the cross of orange male × black female produces male offspring, *all of which are black,* while Doncaster's evidence shows the reciprocal cross to produce male offspring, *all of which are orange.*

We must, therefore, suppose a reversal of dominance to occur in the reciprocal crosses unless we can use the hypothesis of sex-limited inheritance.

If we adopt, tentatively, the hypothesis that the female is a homozygote, XX, and the male is a heterozygote, X —, and if we suppose that black, B, is always coupled with the sex-producing factor, X, we should conclude that the black female is of the gametic constitution, BB, and that the black male is of the composition B —.

The yellow male lacks the factor for the production of black pigment in the coat and is of the gametic composition Y —, while the

[1] *Ann. der Physik.*, Vol. 17, p. 146, 1905.

[1] From the Laboratory of Genetics, Bussey Institution.

[2] *Proc. Camb. Phil. Soc.*, XIII., Pt. I., p. 35, 1904.

yellow female is *YY*. The constitution of these four parent forms would then be: *BB*, black female; *B* —, black male; *YY*, yellow female; and *Y* —, yellow male.

If then we make the cross yellow male, *Y* —, × yellow female, *YY*, all the young should be yellow, one half being males and one half females. In this cross 5 young have been obtained, 3 males and 2 females, *all yellow*.

If we make the cross black female, *BB*, × yellow male, *Y* —, we have in F_1 two types of individuals, viz., *BY*, tortoise females, and *B* —, black male. Theoretically these two types should be formed in equal numbers; actually the tortoise females are 8, the black males 7. The reciprocal cross is yellow female, *YY*, × black male, *B* —; F_1 has two types of individuals, viz., *BY*, tortoise female, and *Y* —, yellow male. This expectation coincides with the facts observed by Doncaster. We have, however, an important cross under way which must be carried out more fully before the hypothesis, given above, can be considered as proved. This mating is: tortoise female, *BY*, × yellow male, *Y* —. The expected result is *BY*, tortoise females; *YY*, yellow females; *B* —, black males; and *Y* —, yellow males. One litter has been obtained from this cross; it contained one tortoise female, one black male and three yellows (dead), the sex of which was unfortunately undetermined before the caretaker discarded them. It is interesting to note that Doncaster cites this mating as producing "blacks, tortoises and oranges," though he does not record the sexes.

The cross tortoise female × black male has been recorded by Doncaster. It gave tortoise females, orange males, black females and black males. By the hypothesis here suggested this is to be expected. Thus tortoise female, *BY*, × black male, *B* —, should give *BB*, black females; *B* —, black males; *Y* —, yellow males; and *BY*, tortoise females.

Male "tortoise shells" occasionally occur, and it seems probable from their rarity that they are due to some distinct mutation such as that which produces tortoise guinea-pigs, and not to heterozygosis between black and yellow. Theoretically, if such were the case, tortoise females of a similar nature might be produced. Such animals would be indistinguishable externally from the common form of "tortoise," but would differ in gametic composition, and therefore in their behavior in crosses.

So far as first-hand evidence goes the observed experimental facts are best explained by the hypothesis outlined above, which considers the factor for black coat color in cats to be linked with the *X* element, and therefore to be sex limited. Doncaster's suggestion that tortoise is merely the female heterozygote obtained in crosses between yellow and black would not explain the fact that reciprocal crosses of black with yellow produce males differing in color, one cross producing black males, the reciprocal cross producing yellow males. Indeed the last-mentioned fact in itself makes the case unique among mammals. If, then, the hypothesis of "sex-limited" characters outlined above is found to be substantiated by the cross, tortoise female × yellow male, we shall have established a case of the same general character as those described by Morgan as occurring in *Drosophila*. Further experiments bearing upon the matter are in progress.

C. C. LITTLE

April 23, 1912

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in the rooms of the society at Philadelphia, April 18 to 21 inclusive, and constituted perhaps the most notable series of sessions ever held by the society. The papers were all of a high order of merit and presented in many cases for the first time the results of original investigation by the authors.

The meeting was opened on Thursday afternoon, President W. W. Keen, LL.D., in the chair, when the following papers were read:

Some Former Members of the American Philosophical Society: THOMAS WILLING BALCH.

The writer said that besides Franklin, the founder of the society, Washington, Jefferson and Cleveland were members. Many other political

men were members: John Dickinson, Albert Gallatin, De Witt Clinton, Alexander James Dallas, Thomas Francis Bayard and Carl Schurz, for example. The painters, Benjamin West, Charles Wilson Peale and Thomas Sully, belonged to the society. Of jurists, John Jay, John Marshall and Roger Brooke Taney were members. Among others whose names are on the roll of the society were: Joseph Bonaparte, King of Spain; Louis Philippe, King of the French; George Gordon Meade, the victor of Gettysburg; Commodore Wilkes, Bishop Charles Magnus von Wrangel, of the Church of Sweden; the Rev. John Witherspoon, of the Church of Scotland and president of Princeton. Among publicists, John Stuart Mill was a member, as also Noah Webster, de Tocqueville, Henry Wheaton, President Woolsey of Yale, Sir Henry Sumner Maine, Henry Charles Lea, Dupont de Nemours, Michel Chevalier. The writer showed that the society had recognized all knowledge in choosing its members.

The Diary of a Voyage to the United States, by Moreau de Saint Méry: Stewart L. Mims. Introduced by Mr. J. G. Rosengarten.

Mr. Mims told the story of his good fortune in finding the diary in the Colonial Archives at Paris, where it had lain covered with dust, all but unnoticed and forgotten, for three generations. The author of the diary was born at Fort Royal, Martinique, in 1750, went to Paris at nineteen to study law and returned to Cap Français (to-day Cape Haiti) in the French colony of St. Domingo, where he practised law for eight years and was then elected to the Conseil Supérieur. The task of codifying the laws of St. Domingo called him back to Paris, where he published successively, from 1784–1790, the six volumes of his famous collection of laws concerning the French West Indies. At the outbreak of the French Revolution he became an ardent champion of the Revolutionary cause. He was made one of the electors of Paris, who governed France during the space of one month. It was as their president that he was "King of Paris during three days." With the accession of Robespierre to power Moreau was forced to flee from Paris into Normandy and later to Havre, whence he took ship for the United States on November 9, 1793. Owing to strong head winds and many storms, his vessel did not reach Norfolk before March 8, 1794. He remained as an exile in this country until August, 1798, when he returned to France.

It is of this sojourn in America that the diary records the story. After calling attention to the value of certain passages where the author records his impressions of such cities as Norfolk, Baltimore, New York and Philadelphia, and to other passages containing the author's comments upon such public men as Washington, John Adams and Alexander Hamilton, Mr. Mims laid special stress upon the interesting material which the diary contains for Philadelphians.

Moreau de St. Méry spent no less than three years and ten months of his exile in this city, maintaining a bookstore and printing shop at Front and Walnut Streets. He offered for sale in his bookstore a large collection of foreign books which attracted many cultured Philadelphians. At his printing press were published in French, besides other works, three of his own well-known books, "La Danse," "La déscription de la partie espagnole de St. Dominique" and "La déscription de la partie française de St. Dominique." Besides, at this same press was published in French from October 15, 1795, to March 14, 1796, a daily newspaper, entitled "Le Courrier de la France et des Colonies," a most unique publication which recorded for the exiles the latest news from France and the West Indies, and served as an organ for the society of Frenchmen who resided then in Philadelphia.

Moreau's shop became in a sense the place of rendezvous for such famous exiles as Talleyrand, Beaumetz, Blacon, de Noailles, Talon, la Rochefoucauld de Liancourt, who had taken refuge "in the ark of Noah," which one of them wittily called Philadelphia at that time. In this connection, the speaker called attention to the very intimate relations existing between Talleyrand and Moreau, stating that the diary contained no less than seventeen unpublished letters from the hand of Talleyrand which were written to Moreau. One passage was quoted from the diary which gave a most striking picture of the famous diplomat, sipping away at a glass of good old Madeira and chatting with his congenial companions, both oblivious of time, until the good wife of Moreau came to drive away the garrulous bishop, reminding him that he might spend his morning lazily in bed, whereas his friend must be up early at the daily duties of his shop. It is interesting to add that Talleyrand, after he had regained power in France, never forgot the friend of his days of exile, but succeeded in reopening the doors of France for his return and providing for his welfare in later life.

In conclusion the speaker expressed confidence that the publication of the diary at the Yale University Press during the coming summer would prove of interest to all students of Philadelphia's history and would add another diary of value to the many interesting records of travel by foreigners in the United States.

The Legendary and Myth-making Process in Histories of the American Revolution: SYDNEY GEORGE FISHER.

Bardaisan and the Odes of Solomon: WILLIAM ROMAINE NEWBOLD.

Sumerian Bookkeeping Five Thousand Years Ago (Illustrated): GEORGE A. BARTON.

The Political Ideals of Ulrich von Hutten: KUNO FRANCKE.

Recent German criticism is inclined to undervalue the services rendered by Ulrich von Hutten to the cause of liberalism. In his personality German humanism finds its most ravishing and irresistible expression. In him the Erasmian enlightenment burns into a revolutionary power. It is a mistake to think of him primarily as an ally of the Lutheran reformation. Hutten would have been the last to submit to the dogmas of the Lutheran church. His aim was the political and intellectual reconstruction of Germany. Abolition of the monasteries, confiscation of church property, secularization of the schools and the higher institutions of learning, safeguarding of free thought and free inquiry, centralization of the empire, limitation of the power of the territorial princes, creation of a powerful public opinion based upon an alliance of the cities and the knighthood—these were his political ideals. If he failed in his efforts to put these ideals into practise, he has at least given a powerful stimulus to the modern conception of the state as the legitimate upholder of liberal culture and spiritual progress.

Some Anthropological Aspects of the Brain with Reference to Race, Sex and Intellect: EDW. ANTHONY SPITZKA.

A discussion of the weight and morphologic appearances of the human brain and its several parts resulting from a series of studies upon specimens of various races and notable individuals, including those of Andamanese, Nicobarese, Chinese, Eskimos, Negroes, as well as eminent scholars from civilized nations. Particular attention is called to the relative redundancy of certain association areas of the cerebral cortex in eminent men and women and also to the relatively larger callosum, or great commissure associating the hemispheres of the brain. The lecture was illustrated by lantern slides.

Waterway Conservation: LEWIS M. HAUPT.

This paper treats of population as the basis of wealth and points out the enormous increase which must follow in the coming century, if the existing ratio continues, which would give a population of nearly 600,000,000 by 2012 and which will seriously tax our political and social conditions, while it also increases enormously the wealth due to the "unearned increment" and the desire to exploit our natural resources.

The great increase in transportation, which has almost doubled in the last decade, is cited as indicating the inability of the overland carriers to cope with the future demand and the absolute necessity of supplementing the railroads by greatly improved water- and highways is urged as a measure of relief and regulation.

Attention is directed to the efforts to secure conservation by statute laws which have become so intricate that great differences of opinion have arisen as to their interpretation, scope and application and a corresponding paralysis has resulted between state and governmental jurisdiction, thus retarding development and increasing the cost of living.

Violations of natural and physical laws have also resulted in great floods and consequent devastation, as is being forcibly impressed by the trail of disaster along the Ohio and Mississippi rivers at the present time, which have overtopped the levees with a lesser discharge than in former years, due to the closure of the outlets and confining of the sediment to the bed of the streams, by the extension of the levees.

These conditions are the sequences of the centralization of authority and control in the general government over all the waters of the country and the general demand from all sections for national appropriations from the federal treasury, which can not be met, and result in sectional jealousies and political pressure for patronage to the great detriment of local initiative and of open competition by states and localities in immediate need of relief.

The illustrations accompanying the paper showed how the energy of currents might be utilized to create automatic channels and remove bars in rivers and harbors at much less cost both for construction and maintenance than by the current means of dredging or the use of extensive jetties

in pairs, which obstruct the tides and create deposits in the pathway of commerce, thus increasing the cost.

On Thursday evening a celebration of the centenary of the introduction of gas as an illuminant, under the auspices of the American Philosophical Society, the Franklin Institute, the American Chemical Society and the American Gas Institute, was held in the hall of the Franklin Institute, Philadelphia, with President Keen in the chair.

A paper on "By-products in Gas Manufacture," by Charles E. Munroe, was read.

Friday, April 19—Morning Session

President Keen in the chair

Heredity of Feeble-mindedness: Henry H. Goddard. Introduced by Dr. Henry H. Donaldson.

The Inheritable Factors of Epilepsy: David F. Weeks. Introduced by Dr. Henry H. Donaldson.

Is the Control of Embryonic Development a Practical Problem? Charles R. Stockard. Introduced by Dr. Henry H. Donaldson.

Many deformities occur among animals in nature and a great number of deformed human beings are born. Many other individuals suffer from minor defects in bodily structure. These defects are often internal and may be unknown to their possessor, yet they frequently give rise to disease conditions which sometimes actually result in death. There are, for example, many congenital defects of the heart and other parts of the circulatory system, digestive tract, reproductive organs and developmental arrests may occur in almost all parts of the body.

These conditions must be regarded as a structural disease which causes the death of a number of children before they are born and handicaps many others throughout their lives. The cause of such defects must be ascertained, then a possible means of control may be found.

Observations on human families and experiments on lower animals prove that these conditions are due to one of two causes as the case may be. First, the embryo may have developed in an unfavorable chemical environment; or secondly, the germ cells of one or both parents may have been defective.

When the eggs of lower animals are treated with various poisons during their development they give rise to monstrous individuals. For example, when developing fish's eggs are treated for a short time with alcohol in some cases as many as 98 in 100 of the eggs give rise to fish which show almost all known deformities of the brain, eyes and other parts of the nervous system.

Guinea-pigs have been put into a state of chronic alcoholism and when such animals are mated either together or with normal individuals the resulting offspring are greatly affected. Many are aborted early in development, or reach term and are then born dead. Only a few are born alive and the great majority of these die after a short time, showing many nervous disorders and dying in convulsions.

A normal female when mated with an alcoholic male gives an almost equally poor result. This shows that the paternal germ cells are affected by the alcohol and are thus rendered unable to give a normal combination and abnormal offspring are produced.

Abnormal and deformed individuals may thus be artificially produced at will and the provoking cause is proved to be an unfavorable chemical environment acting on the germ cells of the parent or directly upon the embryo. The proposition of reversing the experiments thus presents itself, and some mode of treatment or control should be devised by which parents may be put into the proper state to produce as nearly as possible a normally vigorous offspring. Enough is known at present to make the control of development possible to a slight degree at least.

An Avian Tumor in its Relation to the Tumor Problem: Peyton Rous. Introduced by Dr. Alexander C. Abbott.

The paper reports the results of an experimental investigation into the cause of a malignant tumor. For the work a sarcoma of the chicken has been employed. This growth is transplantable from fowl to fowl, and presents the typical picture of a malignant tumor. It has been studied under many different conditions, not only in the adult fowl, but, by a special technic, in the chick previous to hatching.

Attempts to isolate a cause for the sarcoma have been successful. By filtration, or by drying, there can be separated from the living tumor tissue an agent which will produce the growth in fowls previously healthy. This active agent has not been directly observed, and is in all probability ultramicroscopic, since it will pass through filters which hold back minute bacteria. Its properties identify it as a living organism. In giving rise to a tumor it seems able to act only exceptionally and at points and upon tissues which have been

injured in some way. This dependence on a preliminary tissue derangement explains why the disease is not infectious in the ordinary sense.

The chicken sarcoma, like the tumors in general, can not be transmitted to other species; and the facts with regard to its cause must not be taken as applying directly to the tumors of other creatures. But these facts constitute the first demonstration of the cause of a malignant tumor, and they not unlikely illustrate a general truth.

Protein Poison: Its Preparation and Its Nature: VICTOR C. VAUGHAN.

It has long been known that the protein molecule contains a poisonous group. This has been demonstrated by the administration of foreign proteins, parenterally, to heterologous animals. It has also been shown that peptones are poisons when injected subcutaneously and intravenously. The writer, together with Dr. Wheeler in 1903, succeeded in splitting up the protein molecule so as to get a highly poisonous body. This has never been obtained in a state of chemical purity, and its exact composition is not known. Its effects upon animals have been closely studied, and it may be prepared from all kinds of proteins, bacterial, vegetable and animal.

Bacterial Vaccines, with Special Reference to Typhoid Prophylaxis: FREDERICK F. RUSSELL. Introduced by Dr. Alexander C. Abbott.

Alternate Life: ALEXIS CARRELL.

Dynamical Theory of the Globular Clusters and of the Clustering Power Inferred by Herschel from the Observed Figures of Sidereal Systems of High Order: T. J. J. SEE. By title.

Some Notes on Persian Mystic Poetry: A. V. WILLIAMS JACKSON.

FRIDAY, APRIL 19—AFTERNOON SESSION

Vice-president William B. Scott in the chair

Exhibition of Volumes of Illustrations of North American Vegetation: JOHN W. HARSHBERGER.

History of the Fungus of the Chestnut-tree Disease: WILLIAM G. FARLOW.

The Classification of the Black Oaks (Illustrated): WILLIAM TRELEASE.

Attention to bud and fruit characters has led to a classification of the black oaks quite different from their usual arrangement according to leaf-form, and five groups of species are recognized, three of the eastern states, one of the southwest and one of the Pacific states. The eastern groups are the black oaks (black jack, turkey oak, Spanish oak and quercitron), scarlet oaks (scarlet oak, gray oak, Hill's oak, red oak, Texas red oak and bear oak) and swamp oaks, these two sets, the water oaks (water oak, pin oak and Stone Mountain oak) and willow oaks (shingle oak, willow oak, laurel oak, running oak, cinnamon oak and myrtle oak). The southwestern olive oaks (Emory's oak and white-leaf oak) and the Californian holly oaks (evergreen oak, highland oak and Kellogg's oak) are less related to one another and to the eastern black oaks than these are to one another, and appear to have originated independently of these.

The Mammals of the Patagonian Miocene (Illustrated): WILLIAM B. SCOTT.

Illustrations of Remarkable Cambrian Fossils from British Columbia (Illustrated): CHARLES D. WALCOTT.

Dr. Walcott described a very remarkable and ancient fauna that he found in connection with geological explorations in the higher Rocky Mountains of British Columbia. From a camp at 7,000 feet elevation, he climbed a thousand feet to a ledge of rocks where the ancient Cambrian fossils are so perfectly preserved that the internal anatomy of many of the worms and crabs may be reproduced by photography.

His description of the fossils was illustrated by lantern slides made direct from the photographs of specimens representing over fifty genera heretofore unknown. The bay in which the mud was deposited, which now forms the rocks containing the fossils, was connected with the open ocean, and at the spot where the fossils were found the waters must have swarmed with the invertebrate life of the time. No fishes or other vertebrates were found to have existed at this ancient epoch. The earliest vertebrate remains known are several thousand feet higher up in the strata, and are many thousands of years younger than the Burgess shale fossils.

The marine worms are so perfectly preserved that they show not only the exterior form, but the interior intestine and the long proboscis which the worms thrust out through the mouth to secure food and to aid in drawing themselves through the mud.

The crabs show the intestinal canal, liver and a beautiful series of legs, gills and claws connected with the appendages about the mouth.

Specimens of *Medusæ,* or jelly fish, are beautifully preserved, even to the details of the thread-like swimming muscles. Dr. Walcott also showed upon the screen illustrations of the sponges, and many other rare forms of life.

Some Considerations Bearing upon the Origin of Lava (Illustrated): William H. Hobbs.

The ideas which are generally held concerning the origin of lava have all gone out from the idea of a liquid interior to the earth. It has, however, been shown in recent years that the earth can not have a fluid interior, but on the other hand must be as rigid as a ball of glass of the same size. Within the earth the temperatures of the rock would easily melt it under surface conditions, but the pressure from the super-incumbent load elevates the point of fusion and so keeps the rock rigid, or as we might say "solid," though realizing that the condition may in many respects be quite unlike that of bodies at the surface of the earth. There must, however, be local and probably temporary reservoirs which supply the lava which exudes or is rejected from volcanoes. It is shown in the paper that the position of active volcanoes, particularly about the Pacific, suggests that the lava reservoirs which supply their lava have been due to local reliefs from pressure beneath arches of strong formations developed in the process of mountain making. The relative strengths of different sedimentary formations lead inevitably to the conclusion that the type of formation which thus fuses and produces lava, is what is known as shale or slate. Studies of the chemical composition of igneous rocks, which compositions are limited in range, support this view; and the study of the gases which lavas give off affords some further striking confirmations of the theory.

Recent Archeological Discoveries in Peru (Illustrated): Hiram Bingham. Introduced by Mr. Henry G. Bryant.

The Discovery of the Continent of Antarctica by Americans—An Historical Vindication: General Adolphus W. Greely.

The speaker spoke of the unfamiliarity of the people of the United States with early American explorations of the South-polar regions, historical importance of vindicating America's title to the earliest discovery of the Antarctic continent, and to the first explorations that discovered and recognized its continental extent; discovery in 1821 of the northernmost lands of Antarctica, by Captain N. B. Palmer, a Connecticut sealer. Palmer Land was charted by George Powell with South Shetlands in 1822, and recognized by France in 1824. A voyage in 1831 of Master (retired) John Biscoe, R.N., was referred to, whereby Palmer Land was replaced on British charts by Graham Land, named after the first lord of the admiralty. Palmer Land, ignored in the British Antarctic Manual, 1901, is recognized by only two lines in the Americanized Encyclopedia Britannica, 1911, which gives a column to Biscoe and Graham Land.

Emphasis was laid on Wilkes's discovery of extended and widely separated lands in 1840, with their recognition as forming the Antarctic continent, ignored by Capt. J. C. Ross in 1843, discredited by Encyclopedia Britannica in 1875, and declared non-existent by Capt. R. E. Scott, R.N., in 1905. Meanwhile Sir Clements Markham claimed in 1889 the honor of discovering the continent for Ross. British Antarctic Manual, 1901, admits the existence of one point (Knox Land). Mill in 1911 Encyclopedia Britannica admits in general that Wilkes's discoveries are to be indefinitely accepted. Occupation in 1912 by Mawson's Australian expedition of Adelie Land and Termination Land, vindicates Wilkes. Importance of incorporating these facts in appropriate American text-books was urged as a patriotic and educative duty.

The Interrelations of Eight Fundamental Properties of Classes of Functions: Arthur D. Pitcher. Introduced by Professor Eliakim H. Moore.

On Friday evening Professor R. W. Wood, of Johns Hopkins University, delivered a lecture before the society and guests at the College of Physicians on "The Study of Nature by Invisible Light, with Especial Reference to Astronomy and Physics."

The lecture was followed by an informal reception.

On Saturday morning at 9:30 o'clock an executive session was held in the hall of the society at which candidates for membership were balloted for. As a result of the election the following new members were announced: Albert T. Clay, B.A., Ph.D., New Haven; George W. Crile, M.D., Ph.D., Cleveland; Arthur Louis Day, Ph.D., Washington; Edward Curtis Franklin, Ph.D., Washington; John Grier Hibben, Ph.D., LL.D., Princeton; G. Carl Huber, M.D., Ann Arbor; James Furman Kemp, ScD., New York; Arthur Henry Lea, B.A., Philadelphia; John Matthews Manly, Ph.D., Chicago; Edward Bennett Rosa, Sc.D., Ph.D., Washington; Frank Schlesinger, M.A., Ph.D., Allegheny, Pa.; George E. de Schweinitz, M.D., Philadelphia; Frederick Winslow Taylor, M.E., Philadelphia; Roland Thaxter, A.M., Ph.D., Cambridge, Mass.;

Oswald Veblen, Princeton; George Friedrich Julius Arthur Auwers, Ph.D., Berlin; Wilhelm Ostwald, Sc.D., LL.D., Leipzig; Magnus Gustaf Retzius, Stockholm.

SATURDAY, APRIL 20—MORNING SESSION

President Keen in the chair

Some Geochemical Statistics: FRANK W. CLARKE.

The author first discussed the average composition of the igneous rocks, and then compared them with rocks of sedimentary origin. From the amount of soda lost by the decomposition of the igneous rocks, and the amounts retained by the sedimentaries or leached into the ocean, he showed that about 78,000,000 cubic miles of the primitive crust of the earth had been decomposed, forming a mass of rock consisting of about 80 per cent. shales, 15 per cent. sandstones and 5 per cent. limestones. He next compared the rate at which river waters transport dissolved salts to the ocean, with the composition of the ocean itself, and from these data computed the probable age of the earth since the continents assumed their present form at something near 83,000,000 years. The saline matter of the ocean alone amounts to about 5,000,000 cubic miles, or enough to cover the entire surface of the United States with a solid mass a mile and three quarters thick. The rate at which sediments are being deposited in the ocean was also determined, and found to be about 0.000027 inch annually.

Some General Results of the Work of a Century on the Atomic Weights of the Chemical Elements: GUSTAVUS D. HINRICHS.

Absorption Spectra and the Solvate Theory of Solution (Illustrated): HARRY C. JONES.

A large number of lines of evidence have been brought to light in the laboratory of the author, all pointing to the conclusion that a dissolved substance combines with more or less of the solvent in which it dissolves, about 7,000 solutions have now been studied with respect to their power to absorb light. It has been found that a given colored compound dissolved in different colorless solvents absorbs light very differently in the different solvents. This is interpreted as being due to a combination of the different solvents with the dissolved substance, forming the different compounds which absorb light differently. The bearing of this work on the nature of solution is important, and solution is the most important condition known to man from the standpoint of natural science in general.

Matter in the pure homogeneous condition does not enter into chemical reaction. It become active chemically only when dissolved. Chemistry, biology and geology owe their existence to matter in the dissolved state, and any light thrown on the nature of solution is of importance for the natural sciences in general.

The theory of solution hitherto held has been found to be insufficient, not applying to the very solutions that give us natural science.

In dealing with solutions we must always take into account the part of the solvent combined with the dissolved substance.

The Classification of Carbon Compounds: MARSTON T. BOGERT.

The subject is considered primarily from the standpoint of classification for purposes of instruction in organic chemistry. The various ways in which carbon compounds have been classified from time to time are traced historically, from the earliest period to the present, and the author expresses himself in favor at the present day of a classification based on chemical structure, grouping together all compounds of essentially similar function. Thus, all hydrocarbons, saturated and unsaturated, acyclic and cyclic, should be considered together, all simple halogen derivatives, and so forth. The author has used this method with his students at Columbia University for the past ten years and has found it very satisfactory.

An Autocollimating Mounting for a Concave Grating (Illustrated): HORACE CLARK RICHARDS.

Thermal Relations of Solutions: WILLIAM F. MAGIE.

The heat capacity of electrolytes dissolved in water is related to the temperature change of the heat of dilution. Experiments to demonstrate this were described and it was pointed out that the heat of dilution is a difference between two quantities of heat—one evolved in an amount proportional to the absolute temperature—the other absorbed in an amount independent of the temperature. One of these quantities is proportional to the dissociation which occurs on dilution and measures the energy lost by the solute as its ions combine with water. The other involves as a part of its value the heat absorbed by the dissociation.

A formula for the relations of the osmotic pressure to the temperature was proposed, from which the heat of dilution can be deduced. It was shown for solutions of common salt that the constants of this equation can be calculated from the freezing points and the boiling points of the solution, and

that they lead to the observed values of the heat of dilution.

The special significance of these relations lies in the strong support which they give to the theory that the molecules and ions of a salt in solution are associated or combined with the molecules of water.

The Measurement of Temperature up to 1750° C. (Illustrated): Arthur L. Day. Introduced by Professor William F. Magie.

The gas thermometer is the standard thermometer in terms of which all temperatures are defined.

The gas thermometer problem at the present stage of its development has become primarily a problem for experimental study with two definite purposes, one to increase the accuracy of the measurements, the other to increase their range. The range through which temperatures can now be determined in terms of the fundamental definition (the expansion of gas under constant volume or pressure) has now reached nearly to the absolute zero downward, and to 1550° C. upward. The present investigation is concerned with the higher temperatures lying between 300° and 1550°. The accuracy attained in the present investigation within this region is about 0.2° in the vicinity of 300° and 2° at 1550°.

For the purpose of establishing temperatures of reference in this region for general use, the following constants have been determined:

Cadmium (melting point)	320.8 ± 0.1
Zinc (melting point)	419.3 ± 0.1
Sulphur (boiling point)	444.5 ± 0.1
Antimony (melting point)	629.8 ± 0.2
Silver (melting point)	960.0 ± 0.7
Gold (melting point)	1062.4 ± 0.8
Copper (melting point)	1082.6 ± 0.8
Li_2SiO_3 (melting point)	1201.0 ± 1.0
Nickel (melting point)	1452.3 ± 2.0
Palladium (melting point)	1549.2 ± 2.0
Platinum (melting point)	1752.0 ± 5.0

Selective Scattering Reflection and Absorption by Resonating Gas Molecules (Illustrated): Robert Williams Wood.

Some Observations on the Transmission of Sound through Walls: Arthur Gordon Webster.

New Magnetic Charts of the Indian Ocean (Illustrated): Louis A. Bauer.

The charts exhibited embody the results of magnetic observations made during the summer and fall of 1911 on board the non-magnetic yacht *Carnegie* operating under the direction of Dr. L. A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington.

The necessity of the new charts arose from the exceptionally large errors found in the magnetic charts at present in use by mariners. Thus, for example, the errors in the charted compass directions for two of the most recent charts approximate respectively four degrees and six degrees, though one of the charts was issued as recently as 1910. With the exception of a few values found by the vessel used in the Pacific Ocean work, namely, the *Galilee*, these are the largest errors thus far revealed. In the portions of the Atlantic Ocean covered by the *Carnegie* the compass chart errors have generally been below two degrees, though running at times up to two and a half degrees.

The chart errors in the compass directions are usually found to be systematic, that is, in the same direction for large stretches, and are to be ascribed largely to erroneous secular changes allowed for in attempting to bring previously observed values up to date.

Thus, for example, by comparing the *Carnegie* values of 1911 with those obtained on board the German Antarctic vessel, the *Gauss*, in 1903, it is found that the north end of the compass moved to the eastward (hence diminished west declination) at the average rate of about 11′ per year off the southeast end of Africa, whereas in the vicinity of the islands of St. Paul and New Amsterdam in the Indian Ocean (lat. 35° 16′ S., long. 74° 46′ E.) it moved to the westward (increased west declination) at the average rate of about 13′ per year. The charts give secular changes of only about one fourth of these amounts, so that the error of reduction in but ten years amounts almost to 2°. It is doubtless due to these large secular changes disclosed in the Indian Ocean, and especially their rapid variation with geographic position, that the large errors mentioned have crept into the charts.

The errors in the other magnetic elements, while of less importance to the mariner, are of consequence to theoretical investigations regarding the earth's magnetism. In the magnetic dip, the errors on the present cruise have amounted at times to 4°, and in the horizontal intensity to about one twentieth part. While some of the results derived from previous analyses of the earth's magnetic field have pointed to the possibility of large and more or less systematic chart errors, it was not suspected that they would reach

the magnitude disclosed by the work of the *Galilee* and of the *Carnegie*.

The *Carnegie* is at present making a circumnavigation cruise and is expected back in New York towards the end of 1913, having left the same port in June, 1910. Up to February 1, 1912, this vessel has already covered about fifty thousand miles. She left Manila on March 23, in command of W. J. Peters, bound for the Fiji Islands.

Owing to the non-magnetic construction of the *Carnegie* and the absence in consequence of any deviation corrections, it is possible to obtain and communicate results expeditiously. The data are promptly transmitted to the chief hydrographic establishments issuing magnetic charts in order to enable them to make the necessary corrections from time to time.

SATURDAY, APRIL 20—AFTERNOON SESSION

Vice-president Edward C. Pickering in the chair

Symposium on Stellar Spectroscopy—Radial Velocity (Illustrated): WILLIAM W. CAMPBELL.

Our knowledge of motions of the planets around the sun and of the satellites around the planets has been reduced to a system, of remarkable accuracy. Knowledge concerning the motions of the stars is growing rapidly: shall we be able to develop this knowledge into a system?

Stellar motions are studied through their components known as *proper motions* and *radial velocities*. Proper motion studies of the stars have been fruitful, but limited in value by our ignorance of stellar distances. Radial velocities have the advantage that they are independent of stellar distances.

All observed stellar motions contain components due to the motions of the observer. The first step in studies of stellar motions is to determine the elements of the solar motion and to eliminate its effects from the observed motions of the stars, thus leaving the motions with reference to the stellar system.

The direction of the solar motion has long been fairly well known: the solar system is approaching a point 10° or 15° southwest of *Vega*. The speed determined from 1,200 radial velocities is 19½ kilometers (12 miles) per second.

The velocities of the stars are functions of their spectral classes; *i. e.*, of their effective ages. The young stars are traveling slowly—12 kilometers per second, on the average; the middle-aged stars more rapidly—28 ± km. per second; and the old stars the most rapidly—34 ± km. per second. Our sun, as a middle-aged star, is traveling with a speed, 19½ km. per second, far below the average of its class. We do not know why stars increase their speeds as they grow older.

Amongst the brighter and nearer stars those resembling our sun in effective age predominate; and they partake somewhat of the solar motion. Neglecting these brighter middle-aged stars, the remaining stars form a fairly homogeneous mixture of stars of all ages.

Radial velocity data increase our estimate of the scale of the universe about 50 per cent. above proper motion estimates.

Observers with great telescopes have found that one star in eighteen, down to the 9th magnitude, is a double star, and that one in eleven or twelve brighter than the 5th magnitude is double. The spectrograph has shown that *at least one star in four*, down to the 5th magnitude, is a double star; with components so close together that they have never been seen separately in our most powerful telescopes. For young stars the observed proportion is greatest, the components are closer together, and the orbits are rounder. For the old stars the proportion of observed doubles is smallest, the orbits are larger and more elongated. The proportion of discovered doubles, especially amongst the old stars, is rapidly increasing. Conclusion: Double stars have been joined and developed from parent gaseous masses, substantially as mathematical astronomers had predicted. There is the utmost need for cooperation amongst astronomers in observing the radial velocities of stars between the fifth and seventh magnitudes.

Objective Prism Spectra: EDWARD C. PICKERING.

On the Prospect of Obtaining Radial Velocities by Means of the Objective Prism: FRANK SCHLESINGER.

Relations between the Spectra and other Characteristics of the Stars (Illustrated): HENRY N. RUSSELL.

Among the stars whose distances can be measured with some approach to accuracy, and whose real brightness can thus be determined, there exists, with few exceptions, a very marked relation between the actual brightness and the class of spectrum. The stars of spectrum A (resembling Sirius) are on the average about 50 times as bright as the sun; those of spectrum F5 (like Procyon) about five times as bright as the sun; those with spectra like the sun's (class G) are nearly equal to the sun in brightness; while the orange stars of spectrum K average only one sixth as bright, and

the red stars of classes K5 and M are usually less than one fiftieth as bright as the sun. On the average, the stars of each spectral class are seven times as bright as those of the following class. This rule holds true both for the stars relatively near us, whose individual distances can be measured, and for those belonging to clusters whose distances are known.

There exist, however, many stars of great brightness, of all spectral types, which are almost all so remote that their distances can not be accurately measured. From the best available data, these stars appear to be on the average from 100 to 250 times as bright as the sun, without much difference between the different spectral types.

Among the stars redder than the sun, these two groups, of different brightness, are widely separated; but among the whiter stars they run together, and become identical for the whitest stars (class B), which average more than 250 times as bright as the sun.

In the cluster of the Pleiades (whose distance has so far been unknown) all spectral classes from B5 to G are represented, and the relative brightness of the different types follows very closely the law which holds good for the fainter stars already mentioned. If it is assumed that the stars of the Pleiades also follow the same law as regards their actual brightness, the distance of the cluster is found to be such that their light takes 600 years to reach us.

From a study of double stars it is found that the stars of the brighter class do not greatly exceed those of the fainter class in mass, and hence that they are either much less dense, or much brighter per unit of surface, or both. The average density of the stars of classes B and A can be found with the aid of certain stars which eclipse one another, and it follows that these stars give off much more light per square mile of surface than the sun does. It can also be shown that the faint red stars give out much less light per square mile than the sun.

If the same is true of the other kind of red stars (which several lines of argument make very probable) these stars must be of enormous size, but very low density.

An arrangement of all these groups of stars in order of increasing density would begin with the bright red stars of the type of Antares, run up the series of stars of great brightness to those of spectrum B, and then down the series of fainter stars, past those like the sun, to the faintest and reddest stars. It seems probable that this arrangement represents the evolutionary history of a star, which at first becomes heated more and more by its own contraction, and finally, as it becomes too dense to admit of further shrinkage, cools off like a solid body.

At the annual dinner on Saturday evening at the Bellevue-Stratford nearly eighty members and guests were present, the toasts being responded to as follows:

"The Memory of Franklin," by Professor John Bassett Moore.

"Our Sister Societies," by Professor Chas. F. Chandler.

"Our Universities," by Professor Ernest W. Brown.

"The American Philosophical Society," by Professor Francis B. Gummere.

An important feature of this occasion was the presentation of the Henry M. Phillips prize of two thousand dollars to the author of the crowned essay on "The Treaty-making Power of the United States and the Methods of its Enforcement as Affecting the Police Powers of the United States." The successful competitor was Charles H. Burr, Esq., of Philadelphia, the judges of award being Joseph Choate, former ambassador to Great Britain; Judge John C. Gray, of Harvard College; Henry Wade Rogers, dean of the Yale Law School; J. M. Dickinson, former Secretary of War; and Joseph Brown Scott, of the Department of State at Washington.

In their sealed verdict the judges declared that they found great difficulty in deciding the essay of Mr. Burr and that of Edward S. Corwin, of Princeton University.

Arthur Willis Goodspeed

SOCIETIES AND ACADEMIES

THE TENNESSEE ACADEMY OF SCIENCE

On March 9, 1912, a meeting was held in Nashville, Tennessee, to make plans and prepare a constitution for a Tennessee Academy of Science. The meeting was called by Dr. Geo. H. Ashley, then state geologist.

The first general meeting, which was largely attended, was held at the Carnegie Library, Nashville, on April 6, at which time the following officers were elected: C. H. Gordon, president; J. I. D. Hinds, vice-president; Wilbur A. Nelson, secretary, Capitol Annex, Nashville; S. M. Barton, treasurer, and E. S. Reynolds, editor; after which the following papers were read:

"On the Reported Discovery of Radium in Arkansas," A. H. Purdue, former state geologist of Arkansas.

"Neon and Wireless Waves," William L. Dudley, Vanderbilt University.

"Rock Striations and their Causes," Chas. H. Gordon, University of Tennessee.

"Railroad and Road-building in Tennessee before Civil War," Gus Dyer, Vanderbilt University.

"The Beginning of Music," R. M. Ogden, University of Tennessee.

"Food and Drug Inspection in Tennessee," Lucius P. Brown, Tennessee Food and Drug Inspection.

"Review of 'History of Geological Work in Tennessee,'" L. C. Glenn, Vanderbilt University.

"Some Remarkable Phenomena of the Tornado in Montgomery County, Tennessee, April 29, 1909," James A. Lyon, S. P. University.

"Some Effects of Parasitic Fungi on Leaf Tissue," Ernest S. Reynolds, University of Tennessee.

"Photomicrography in Colors by the Lumière Process" (illustrated); "An Apparatus for Washing Fixed Microscopic Material" (illustrated), Samuel M. Bain, University of Tennessee.

"The Selection of Food in Unicellular Animals" (illustrated), Asa A. Schaeffer, University of Tennessee.

"Electrical Conductivity in Dental Fillings," John Daniels, Vanderbilt University.

WILBUR A. NELSON,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

THE meeting of the academy was held at the academy building on Monday, April 1, 1912, at 8 P.M., President Engler in the chair.

Dr. G. O. James, of Washington University, addressed the academy on "The Application of the Relativity of Gravitation to the Motion of the Perihelion of Mercury."

J. L. Van Ornum, professor of civil engineering at Washington University, reviewed the methods practicably applicable to prevent dampness in rubble masonry foundation walls; that is, by drainage or by an impervious coating of their exterior, or by both. Impermeability may be attained by constructing an impervious diaphragm of a bituminous material; by an efficient surface coating, preferably on the outside; by carefully securing a maximum density by properly proportioning the components of the concrete; or by mixing with the concrete certain colloidal (or other) substances to secure this result. The latter two methods have been experimentally investigated in successive years as thesis work by H. F. McFarland, P. C. Grace, S. Johnson and W. K. Begeman. Their results agree in general with those of others in concluding that, for any usual conditions, the patented mixtures sold for this purpose vary in effectiveness from very poor to very good; and that proper proportioning of the constituents of the concrete to attain a maximum density, such as is desirable to secure a maximum strength, will also effect practical impermeability; but they differ from the conclusions of some others in the fact that they found no advantage to result from the incorporation of such a material as hydrated lime in the richer mixtures.

The apparatus designed by the students for these experiments, which gave pressure up to forty pounds per square inch, was planned to eliminate certain features of the experimental devices of others which seemed objectionable to them; particularly in eliminating tensile stresses from the specimens tested, with the resulting tendency to form cracks.

Professor Nipher gave a preliminary discussion of a phenomenon observed by Planté. It is the buckling of a fine wire through which an electric discharge is passed. Professor Nipher finds that a long and very fine fuse-wire of lead, lying on a strip of glass, usually breaks at the positive end, at a point where it is made fast by sealing wax. The wire at the same time is urged towards the negative terminal, as positive ions are in a gap of air. The metal wire behaves like the positive column in discharge through gases. The negative end of the wire appears to be urged in the opposite direction, as is also the case at the negative terminal in discharge through gases. It sometimes happens that the wire breaks down at the negative end. Nearly all of the wire, however, appears to have the property of the positive column. It is urged longitudinally in a direction opposite to that in which the negative corpuscles are being conducted. Fine copper wire is now being used, and the ends of the wire are left free to move, while the wire is sealed to the glass strip at various intermediate points. The conditions which determine the limiting point between portions of the wire which are being urged in opposite directions have not yet been fully ascertained. The positive ions which constitute the copper wire are not quite as free to "wander" as they are in the case of solutions, or in discharge through gases.

Present indications are that practically all of the fine wire is being urged in a direction opposite to that of the corpuscular flow. There must, however, be an end effect at the negative terminal of the wire which urges the wire in the opposite direction.

At the meeting of the academy held Monday evening, April 15, 1912, Professor A. S. Langsdorf, of Washington University, addressed the Academy on "Transient Electrical Phenomena," Dr. Chas. H. Turner gave an illustrated account of "Results of Recent Experiments on the Homing of Ants," Dr. Arthur E. Bostwick read a paper on "Atomic Theories of Energy" and Professor Wm. H. Roever, of Washington University, exhibited and explained "A Mechanism for Illustrating Lines of Force."

George T. Moore,
Corresponding Secretary

THE TORREY BOTANICAL CLUB

The meeting of January 31 was held in the Museum Building of the New York Botanical Garden, Vice-president Barnhart presiding. Twenty-five persons were present. The minutes of the meetings of November 29, 1911, and January 9, 1912, were read and approved. Dr. Marshall A. Howe, chairman of the auditing committee, reported that the committee had examined the books of the treasurer and found them to be correct. The report of the budget committee was presented and approved.

The announced scientific program consisted of the reading of papers on "Sir Joseph Dalton Hooker: His Life and Works," by Dr. N. L. Britton and Dr. J. H. Barnhart. Dr. Britton's paper related chiefly to the life of this distinguished botanist, and his publications relating to botany were discussed by Dr. Barnhart. As Sir Joseph Hooker was an honorary member of the Torrey Club, Dr. Barnhart took this occasion to bring before the club the constitutional provisions relating to honorary membership and read the list of all persons who have been elected to honorary membership.

Mr. Fred J. Seaver spoke briefly on the viability of the spores in *Pyronema*. While *Pyronema* has been made the subject of numerous research papers and is figured and treated in most of the recent text-books of general botany, it still remains an unknown plant to most botanists, except to the few who have done critical work with it. There is no reason for it being so, for the fungus is fairly common and is easily grown, as has already been shown in previously published papers. In a recent experiment the speaker was able to show that the spores of this fungus which had been kept nearly three years in the herbarium germinated readily in hanging-drop culture. This last point should be of general interest to teachers of botany, since it means that the plant can be grown and studied from living material and the old plants then placed in an envelope and kept until the next year, when they can be planted and grown again. No complicated technique is necessary for the growing of *Pyronema*. A pot of garden soil should be heated. Heating can be carried on in an autoclave or sterilizing oven. If these are not to be had bake in an ordinary oven. Saturate the soil with tap water after heating and plant the spores. Growth of mycelium should be abundant in two or three days, sex organs should appear in about a week, and mature ascocarps a few days later. A more detailed account of this subject will appear in the *Bulletin* of the club.

Dr. Marshall A. Howe spoke briefly on "Some Marine Algæ from the Stomach of a Peruvian Green Turtle" and exhibited specimens from the source indicated, collected in Peru by Dr. Robert E. Coker. The fragments were in a good state of preservation and two of the species concerned are readily determinable, the most abundant being *Rhodyminia flabellifolia*, a common Peruvian and Chilean species and a close relative of the edible "dulse." The alga coming next in point of abundance is *Caulerpa flagelliform lingulata*, a species occurring elsewhere in Dr. Coker's Peruvian collections, but not before reported from the shores of the American continent. Fragments of a species of *Gelidium* not so certainly determinable also occur.

Dr. W. A. Murrill gave a short account of the progress of his studies on the Agaricaceæ of tropical North America and also read some mycological notes relating to the Washington meeting.

The meeting of February 13 was held at the American Museum of Natural History at 8:15 P.M. Twenty-three persons were present.

The announced scientific program consisted of a lecture on "Some Botanical Features of a Desert Mountain Range," by Dr. Forrest Shreve. The lecture was illustrated with lantern slides.

B. O. Dodge,
Secretary